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Osseous and muscular systems
simplified for physical education
students

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THE OSSEOUS AND MUSCULAR SYSTEMS
SIMPLIFIED FOR THE PHYSICAL EDUCATION STUDENT

Submitted by

Franklin Eden Leeds

(B. S. in Ed., B. U., 1931)

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The Osseous and Muscular Systems
Simplified for the Physical Education Student

The purpose of this thesis is to simplify the Osseous and Muscular Systems for the needs of the Physical Education student.

In this treatment of the Osseous system I have not given a detailed description of each bone, but just a short sketch of each bone to the extent a Physical Education student should know it. I have purposely made these descriptions short, and included the drawings which I hope will make up for the shortage of description. By that I mean that the student can get a better idea of the Osseous system by visualizing the pictures and placing in his mind the exact location of each characteristic of each bone.

After he has these characteristics firmly placed in his mind, he can proceed to the muscular attachments of each bone and by comparing the two get a better idea than if he simply read about it. I have divided the muscular attachments into those that insert and those that arise from each bone, and have shown in the drawings of the muscular areas, just how much each muscle takes up, and its location on the bone. Thus by comparing the characteristics and muscular areas the student is better qualified to figure out action and thus he can adapt certain exercises to his findings.

As for the muscular system itself, I have divided the muscles into group action, i. e. muscles acting on the different joints, and then divided each group into the recognized actions of the Physical Education student, i. e. flexion, extension, abduction, adduction, etc. I have given the muscles involved in each action without their origins and insertions.

After the student reads about the origin and insertion on any bone, I expect him to turn to the drawings of the bones and muscular areas and find out just where the muscle is located and try to visualize its action.

I think that if the student goes over the Osseous system first and learns the general characteristics, then learns the muscular attachments, he will have a much easier time when it comes to locating muscles and finding out just what the action is.

First of all I believe the Physical Education student should know of the distinguishing anatomical characteristics of the body. For instance, he should know the anatomical position, or that position in which the body is studied, is supposed to be standing, with the arms at the side, and the palms of the hands facing forward. He should know that the arm extends only from the shoulder to the elbow and below that point to the wrist it is known as the forearm and not the arm as most people think; that below the wrist on the thumb side (palmar surface) we have what is called the Thenar eminence, that on the little finger side we have what is called the Hypothenar eminence, that the back of the hand is called the dorsal surface. He should know that the entire lower extremity is not the leg as most people would think, but that the lower extremity is divided into the thigh, that portion which runs from the lower part of the torso to the knee, and the leg which runs from the knee to the ankle.

He should know that the head is divided into the cranium and the face, subdivisions of the cranium being occiput at the back, the forehead in front, and the temples at the sides. The face would include the chin, cheeks, nose, eyes, and mouth. Below the head is the neck which connects it to the **trunk.** The front is called the throat, and the back the neck,

or nape.

The trunk is divided into the upper portion or chest (thorax) and the lower portion or belly (abdomen). The two are separated by the lower border of the ribs and the lower end of the sternum, on the surface. Within the floor of the thorax and the roof of the abdomen is formed by the diaphragm, a dome-shaped muscle which is recognized as the separation of, or the partition between, the two cavities. As this dome projects into the upper cavity, the thorax is smaller than appears on the surface, and the lower cavity is much larger, allowing more room for the abdominal organs.

The bottom portion of this abdominal cavity is recognized as the pelvic cavity which is divided by a narrow bone ring, the pelvic inlet, into the large, false pelvis above, and the small, true pelvis below. The small or true pelvis contains the bladder, rectum, and some of the generative organs.

For the sake of anatomical terminology I think the following should be known:

Most anatomists have agreed to call the head end of a man anterior, the opposite end, posterior; the side containing the backbone, dorsal, and the opposite side, ventral. Anterior is the same as superior, and posterior is synonymous with inferior. The head end is also spoken of as superior and the opposite end inferior. The median or sagittal line refers to an imaginary line drawn through the middle of the body from the top of the head through the sagittal suture to the floor at a middle line between the feet, dividing the body into right and left halves. The parts nearest this

line are described as mesial, the parts farthest from this line are described as latera l. Proximal is used to describe a position near the source of any part. Distal is used to describe a position distant, or farthest away from the source of any part. Thus we speak of the proximal end of the arm, and the distal end of the finger. In anatomy the term periphery means the outside or surface of a body or an organ.

Now that I have given a working knowledge of the locations of the body I am going to start describing the systems to the extent a Physical Educator should know them.

The first system I am going to take is that of the bones, the study of which is called Osteology. First of all I think we should know the function of these bones which is as follows:

They form the framework or skeleton of the body and are the principal organs of support, and the passive instruments of locomotion. Connected together in the skeleton they form a framework of hard material, affording attachment to the soft parts, maintaining them in their due position, sheltering such soft parts which are concerned in the more vital functions, as the brain, thoracic, abdominal and pelvic viscera. Finally they give stability to the whole body and help in preserving its shape.

Next I think should come the classification of bones. They are divided, according to their shape, into four classes: long, short, flat and irregular.

A long bone consists of a shaft and two extremities. The shaft is formed mainly of compact tissue, this compact tissue being thickest in the middle, where the bone is most slender and the strain greatest, and

it is hollowed out in the interior to form the medullary canal. The extremities are made of cancellated tissue with only a thin coating of compact substance, and are more or less expanded for greater convenience of mutual connection, and to afford a broad surface for muscular attachment. All long bones are more or less curved, which gives them greater strength. They are found in the extremities, for instance, the femur or humerus.

A short bone is a small piece of bone irregularly shaped. Their texture is spongy throughout, excepting at their surface where there is a thin crust of compact substance. The short bones are the sixteen bones of the carpus, the fourteen bones of the tarsus, and the two patellae.

Flat bones are found where the principal requirement is either extensive protection or the provision of broad surfaces for muscular attachment. The bony tissue expands into broad or elongated flat plates which are composed of two thin layers of compact tissue, enclosing between them a variable quantity of cancellous tissue, for instance, the occipital bone.

The irregular bones are those which, on account of their peculiar shape, cannot be grouped under either of the preceding groups. The vertebrae are a good example. The bones of the ear are so small that they are described as ossicles and do not fit in any of the above groups.

In examining the surface of any bone we find certain projections and depressions. The projections are called processes and the depressions are called fossae or cavities. They are divided into Articular and Non-articular. The articular are provided for the mutual connection of bones to form joints. The non-articular serve for the attachment of ligaments and

muscles. The following terms should be in the mind of the Physical Educator to understand the attachment of muscles to bones and openings through which nerves and blood vessels go.

Cavities.	The terms sinus and antrum are applied to cavities within certain bones. Also the term sinus is used in surgery to denote a narrow tract leading from the surface down to a cavity.
Condyle.	A rounded or knuckle-like process.
Crest.	A narrow ridge of bone.
Fissure.	A narrow slit.
Foramen.	A hole or orifice through which blood-vessels, nerves and ligaments are transmitted.
Fossa.	A depression in or upon a bone.
Groove or sulcus.	A furrow.
Head.	A portion supported on a constricted part or neck.
Meatus or Canal.	A long tube-like passageway.
Process.	Any marked bony prominence.
Spine or Spinous Process.	A sharp or slender process.
Trochanter.	A very large process.
Tubercle.	A small, rounded process.
Tuberosity.	A large, rounded process.

Now that we have a general idea of the types of bones and their markings we will proceed to take up the divisions of the skeleton. Generally the skeleton is divided into an Axial Skeleton and an Appendicular Skeleton. They in turn are divided as follows:

Axial Skeleton	1. Head or skull	(Cranium (Face
	2. Hyoid	
	3. Trunk	(Vertebrae (Sternum (Ribs
Appendicular Skeleton	4. Upper extremities	
	5. Lower extremities	

Next we will take up with some detail the different parts of the above divisions.

First the head or skull which rests upon the spinal column and is formed by the union of the cranial and facial bones. The bones of the cranium are as follows, eight in number:

Occipital, base of skull	1	
Parietal, crown	2	
Frontal, forehead	1	= 8
Temporal, ear region	2	
Ethmoid, between cranial and nasal cavities	1	
Sphenoid, base of brain and back of orbit	1	

The occipital bone is situated at the back and base of the skull or technically speaking the posterior-inferior part of the cranium is formed by the occipital bone. On this are several points of interest. A large foramen (foramen magnum) gives passage to the spinal cord as it passes from the brain into the spinal canal, which is formed by the spinal foramen of the vertebrae. Anteriorly to the foramen are two articular processes where the skull rests upon the first vertebra or atlas and articulates with it. The posterior surface presents a prominent process of bone called the occipital protuberance.

The parietal bones, left and right, form by their union the greater part of the sides and roof of the skull, or what is known as the crown of the skull. These two bones are united by a suture in the middle of the

skull called the sagittal suture. The posterior portion of these parietal bones unites with the occipital bone by means of the occipital suture.

The frontal bone forms the greater portion of the forehead and enters into the formation of the roof of the orbits, and of the nasal cavity. The arch formed by part of the frontal bone over the eye is sharp and prominent, and is known as the supraorbital margin. Just above the supraorbital margins are hollow spaces called the frontal sinuses which are filled with air and open into the nose. In the upper and outer angle of each orbit are two depressions called lacrimal fossae for the reception of the lacrimal glands, which secrete the tears. The internal surface of the frontal bone lodges the anterior lobes of the brain, or that portion said to contain the intellectual centers. At birth the bone consists of two pieces which afterwards becomes united along the middle line by a suture which runs from the vertex of the bone to the root of the nose. This suture usually becomes obliterated within a few years after birth, but it occasionally remains throughout life.

The temporal bones are right and left and are situated at the sides and base of the skull. They are named temporal from the Latin word tempus, time, as it is on the temples the hair first becomes gray and thin, and thus shows the ravages of time. They are described as having three distinct portions, a hard, dense portion called the petrous portion which contains the internal ear and the canal leading thereto, and supports the cartilaginous external ear or auricle, a thin and expanded scale-like portion called squamous and gives attachment to several muscles concerned in mastication; and a mastoid portion which is prolonged downward

and forms the mastoid process. This process is filled with a number of connected cancellous spaces, containing air, and called mastoid cells. They communicate with the cavity of the middle ear. The condition known as mastoiditis means inflamation of the lining of these cells.

The internal ear, the essential part of the organ of hearing, is contained in a series of cavities, channeled out of the substance of the petrous portion. Between the squamous and petrous portions is a socket, called the glenoid fossa, for the reception of the condyle of the lower jaw, or mandible.

The Ethmoid bone is an exceedingly light cancellous bone consisting of a horizontal or cribiform plate, a perpendicular plate and two lateral masses or labyrinths. The lateral masses contain a number of thin-walled cavities called the ethmoidal sinuses, which communicate with the nasal cavity. It is a rather small bone and helps to form the nasal and orbital fossae.

The Sphenoid bone is situated at the anterior part of the base of the skull and binds the other cranial bones together. It helps to form the cavities of the cranium, orbits, and nose. In shape it resembles a bat with extended wings, and is described as consisting of a body, two pairs of wings, and two pterygoid processes which projects from it below. The body is joined to the ethmoid in front and the occipital behind. It contains the cavities which are known as the sphenoidal sinuses which communicate with the naso-pharynx.

Now that we have a general description of the bones of the Cranium, we will next take up the bones of the face. They are as follows, fourteen in number:

Nasal	2	
Vomer	1	
Inferior nasal concha (Inferior turbinated)	2	
Lacrimal	2	= 14
Zygomatic (malar)	2	
Palatine (palate)	2	
Maxilla (upper jaw)	2	
Mandible (lower jaw)	1	

The nasal bones are two small oblong bones placed side by side at the middle and upper part of the face, forming by their junction the bridge of the nose.

The vomer is a single bone placed at the lower and back part of the nasal cavity, and forms part of the central septum of the nasal cavity.

The inferior nasal conchae or turbinated bones are situated in the nostril, on the outer wall of each side. Each consists of a layer of thin, cancellous bone.

The lacrimal bones are the smallest and most fragile bones of the face. They are situated at the front part of the inner wall of the orbit, and resemble a finger-nail in form, thinness, and size. They are named lacrimal because they contain part of the canal through which the tear duct runs.

The zygomatic, or malar bone forms the prominence of the cheek and part of the outer wall and floor of the orbit. A spine of bone projects backward from the body and unites with a corresponding spine which projects forward from the temporal bone, thus making the arch which is known as the zygomatic arch.

The palatine bones are "L" shaped and consist of a horizontal, a ventral part, and three processes, the pyramidal, orbital, and sphenoidal processes. They help to form the back part of the roof of the mouth; part

of the floor and outer wall of the nasal cavities; and a very small portion of the floor of the orbit.

The maxilla, or upper jawbones, also known as the superior maxillary, are two in number, right and left. They assist in forming part of the floor of the orbit, the floor and outer wall of the nasal cavities, and the greater part of the roof of the mouth. The portion of the bone which contains the teeth is called the alveolar process, and is excavated into cavities, varying in depth and size according to the size of the teeth they contain. The body of the bone is hollowed out into a large cavity known as the antrum of Highmore.

The mandible, or lower jaw-bone, also known as the inferior maxillary is the largest and strongest bone of the face and consists of a curved horizontal portion, the body, and two perpendicular portions, the rami. This bone serves for the reception of the lower teeth, and undergoes several changes in shape during life, owing mainly to the first and second dentition, to the loss of teeth in the aged, and subsequent absorption of that part of the bone which contained them. It articulates by its condyles with the sockets in the temporal bones, which allows for free movement in mastication.

The above classification covers the bones of the cranium and the face and I will just mention in passing that lying in front of the throat, just above the laryngeal prominence, or in other words the Adam's apple, there is an isolated U-shaped bone called the hyoid bone. This bone supports the tongue and gives attachment to some of its numerous muscles.

Next we will take up that portion of the body known as the trunk and the bones that enter into its formation. These are the vertebrae, the sternum, and the ribs.

First we will study the vertebrae, more commonly known as the vertebral column. That is to say this column is composed of a number of bones called vertebrae. In man it is about twenty-eight inches long, and the vertebrae are only twenty-six in number due to the ossification of the sacral and coccygeal vertebrae; thus making in youth a total of thirty-three vertebrae, because the bones of the sacral and coccygeal vertebrae are recognized as separate bones. The union of these vertebrae does not take place until later life. They are classified as follows:

		Child	Adult
	(Cervical	7	7
True	(Thoracic	12	12
	(Lumbar	5	5
False	(Sacral	5	1
	(Coccygeal	4 = 33	1 = 26

Due to the upper three portions of the spine being separate and movable throughout the whole life, they are classified as true vertebrae. And due to the union of the sacral and coccygeal in adult life they are classified as false vertebrae. These false vertebrae complete the wall of the bony pelvis.

Each vertebra consists of a solid part, the body or centrum, and an arch made up of two parts, the pedicles and the laminae. This arch supports the articular, transverse, and spinous processes. There are four articular processes, two to connect with bone above and two to connect with bone below. There are two transverse processes one at each side, and one spinous process, which projects backward. The cavity which

is in the center forms part of the neural or spinal canal for the spinal cord. The above is a general description of a typical vertebra, and now I will take up the general characteristics of each type.

First the cervical vertebrae: in this region of the vertebral column the bodies of the vertebrae are smaller than in the thoracic, but the arches are larger. The spinous processes are short, and often cleft in two, or bifid. The transverse processes are pierced by a foramen for the passage of blood vessels and nerves.

The first and second cervical vertebrae differ considerably from the rest. The first, or atlas, is so named because of its function in supporting the head. It has practically no body, and may be described as a bony ring divided into two sections by a transverse ligament. The dorsal section of this ring contains the spinal cord, and the ventral or front section contains the bony projection which arises from the upper surface of the body of the second cervical vertebrae, the axis. This bony projection is called the odontoid process and forms a pivot on which the atlas rotates when the head is turned from side to side, carrying the skull, to which it is firmly articulated.

The thoracic or dorsal vertebrae have larger and stronger bodies than those of the cervical, and have a facet or demi-facet for articulation with the vertebral end of a rib.

The lumbar vertebrae have the largest and heaviest bodies of the whole spine. In addition they have a mamillary process, which the other vertebrae do not have.

The sacral vertebrae form by their union the sacrum, which is a

large triangular bone situated like a wedge between the coxal bones, and is curved upon itself in such a way as to give increased capacity to the pelvic cavity.

The coccygeal vertebrae form by their fusion the coccyx bone and is recognized as the most rudimentary part of the vertebral column.

Next we will take up the spinal column as a whole. The spinal column is the central axis of the body and is in the median line and dorsal part of the trunk. It supports the head, the ribs, and the upper extremity. The weight of these parts is transmitted through the spinal column to the lower extremities through the hip-bones with which the sacrum articulates.

This spinal column consists of the row of vertebral bodies and of the row of neural arches and their processes. The bodies are connected by intervertebral disks of fibro-cartilage, which represent about one-quarter of the total length of the spine, and by various ligaments. The bodies give origin to certain muscles which act on the ventral aspect of the spine. The row of bodies supports the weight of the head and trunk, and the movements of what the spine is capable occur in the disks between the bodies. The column of bodies and disks is mechanically the most important part of the spine. The arches are also connected by various ligaments, give attachment to the axial muscles which act on the dorsal aspect of the spine, and complete the boundaries of the spinal or vertebral canal which contains the spinal cord, the membranes surrounding the cord, and the origins of the spinal nerves.

The intervertebral foramins are found between each pair of pedicles and permit the passage of the spinal nerves and the spinal arteries and veins. In the thoracic region the laminae overlap, while in the cervical

and lumbar regions, especially in the latter, there is a space between them.

From the standpoint of Physical Education this spinal column plays an important part. It is the background of good posture and that is what the Physical Education man is after. This spine is not straight, as most people think, but it is made up of four curves. The thoracic and sacral curves which are concaved forward and appear during embryonic life give greater room for the organs in the thorax, abdomen, and pelvis, and are known as primary curves. The next set of curves are the cervical and lumbar curves which are convexed forward and are shorter and sharper than the other two. They appear after birth and are known as the secondary curves. The cervical curve appears when the child begins to hold up its head; the lumbar curve appears when the child begins to assume the erect position. They are due to the need of supporting weight. The cervical and lumbar curves are deeply seated in the trunk and are covered in behind by the deep muscles of the neck and loins. The thoracic and sacral curves are very near the surface. The cervical curve extends from the top of the spine to the top of the second thoracic vertebra; the thoracic curve from the second to the eleventh thoracic; the lumbar curve from the eleventh thoracic to the promontory of the sacrum. The line of gravity of the head and neck passes through the points where the curves join each other. The curves are comparable to a series of superimposed springs and the elasticity they give is of great importance in enabling the spine to carry weight with a minimum of muscular effort.

As a result of injury or disease the normal curves may become exaggerated

and then are spoken of as curvatures. If the thoracic curve is exaggerated it is called kyphosis or humpback; if the exaggeration is in the lumbar region it is called lordosis or hollow back. If the curvature is lateral, i. e. toward one side, it is called scoliosis. Lateral curvature is usually to the right side, because even in healthy people there is often a slight curve toward the right in the thoracic region.

The spine is freely movable, the various movements depending on the compression or stretching of any given disk. While there is only very slight movement between any two vertebrae, there is a considerable range of movement when the spine is considered as a whole. The movements are most free in those regions where the disks are thickest; consequently movements are more marked in the neck and loins and much more limited in the thoracic region where the ribs also tend to restrict motion. There is of course none in the sacral region, with the exception of a little play between the sacrum and coccyx. Flexion and extension of the spine, bending forward and backward, are most marked in the neck and loins, but are limited in the thoracic region. Lateral movement, bending from side to side, is free in the neck and lumbar region, but limited by the ribs in the thoracic region. Rotation is freest in the neck, fairly free in the upper thoracic region, but very slight in the lumbar region due to the peculiar shape of the lumbar articular processes. Lateral motion is always associated with some rotation, a fact of practical importance in the condition known as lateral curvature of the spine.

The breast bone of sternum is found on the front wall of the thorax. It is a flat thin bone about six inches long and develops as three parts.

The head or upper part is called the manubrium and has articulations for the clavicle and costal cartilage of the first rib. The second part or middle portion is the largest section and is termed the body, or gladiolus which contains articulations or notches for the sternal ends of the second, third, fourth, fifth, sixth, and seventh costal cartilages. The bottom or inferior portion is called the ensiform or xiphoid process and does not have any of the ribs attached to it, but it offers attachment for some of the abdominal muscles.

The ribs are twenty-four in number, or twelve pairs. That is to say we have twelve ribs on each side of our thoracic cavity. The first seven of these ribs are attached to the sternum by means of the costal cartilages which serve as buffers and increase elasticity of the chest wall. These seven ribs are also connected to the thoracic vertebrae at the back by means of strong ligaments. They are called true ribs. The next three ribs are attached indirectly to the sternum by means of the costal cartilage of the rib above and are also connected to the vertebrae. Due to this they are called false ribs. The last two ribs are attached only to the vertebrae and thus are termed floating ribs.

A typical rib may be described as having a shaft and two extremities. The first two and last two ribs differ from the middle eight ribs which are typical ribs. At the vertebral end of a typical rib is the enlarged head which is joined by a constricted neck to the shaft. This head articulates with the bodies of the vertebrae. Just where the neck joins the shaft is a prominence of bone called the tubercle which articulates with the transverse process of a vertebra. The shaft itself begins at this

tubercle and extends to the sternal end where an articular surface receives the costal cartilage.

The convexity of the ribs is turned outward so as to give roundness to the chest and increase the size of its cavity. Each rib slopes downward from its vertebral attachment in such a manner that its sternal end is considerably lower than its dorsal end. The spaces left between the ribs are called the intercostal spaces.

The first rib is short, broad and so placed that the surfaces face up and down. It has a groove for the subclavian artery and subclavian vein, the two grooves being separated by the scalene tubercle.

The second rib is longer and lacks the curve that the others have on the horizontal axis.

The eleventh and twelfth ribs are short and lack several of the characteristics of a typical rib, as tubercle and angle.

The Thorax

The thorax is formed by the thoracic vertebrae, the twelve pairs of ribs and their cartilages, and the sternum in front. This bony thorax forms an irregular cone, the ventral wall being shorter than the dorsal.

The apex of the cone is formed by the first thoracic vertebra, the first pair of ribs, and the upper part of the sternum. This space is known as the inlet of the thorax, while the outlet is bounded by the last thoracic vertebra, the twelfth pair of ribs, the lower borders of the eleventh to the seventh pairs of ribs, and the xiphoid cartilage. This large opening is closed by the diaphragm muscle.

The thorax contains the organs of respiration and circulation, and

not only protects them but allows the movements necessary to their proper functioning. It also supports the bones of the shoulder girdle and upper extremities.

Appendicular Skeleton

The Appendicular skeleton is divided into the upper and lower extremities.

Bones of the Upper Extremity

Clavicle	1
Scapula	1
Humerus	1
Ulna	1
Radius	1
Carpus	
Navicular (Scaphoid)	1
Lunate (Semilunar)	1
Triangular (Cuneiform)	1
Pisiform	1
Greater Multangular (Trapezium)	1
Lesser Multangular (Trapezoid)	1
Capitate (Os magnum)	1
Hamate (Unciform)	1
Metacarpus	5
Phalanges	14
	32

The Clavicle

The clavicle lies in the upper part of the pectoral region. Its inner or sternal end articulates with the sternum. Its outer or acromial end articulates with the acromion process of the scapula. The shaft of the bone is curved in two directions and is weakest at the point where the two curves meet.

Muscular attachments of the Clavicle

The clavicle gives insertion to two muscles. The trapezius (from the spines of the vertebrae) which inserts partly into the dorsal border

of the outer third of the shaft; and the subclavius (from the first rib) which inserts into the inferior aspect of the shaft. The clavicle provides origin for the following muscles. The clavicular head of the sterno-mastoid arises from the upper surface near the sternal end and passes to the temporal bone. The pectoralis major arises from the inner two-thirds of the anterior surface, the deltoid from the outer third, and both these muscles pass to the humerus. The sterno-hyoid arises partly from the posterior aspect of the sternal end of the shaft.

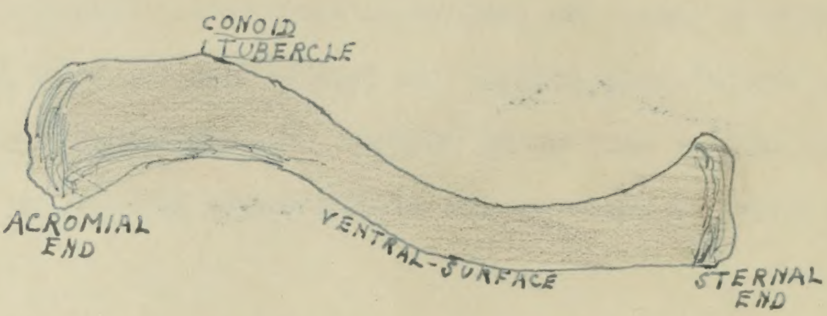
The Scapula

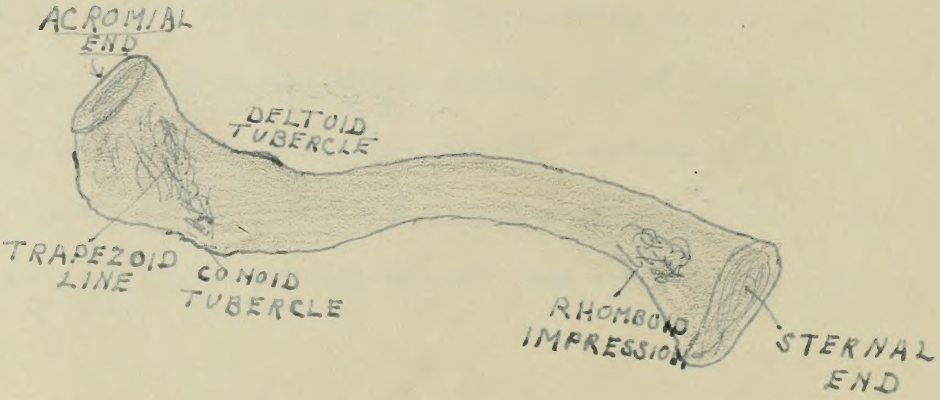
This is a large flat bone, triangular in shape, and placed between the second and eighth ribs on the back part of the thorax. It has three angles, external, superior, and inferior; three borders, superior, vertebral, and axillary; two surfaces, dorsal and ventral. At the end of the axillary border it has a neck and a glenoid fossa. Separating the Supraspinous fossa and the Infraspinous fossa there is a spine which ends in the acromion process. On the ventral surface there is a subscapular fossa, and the coracoid process. The following diagrams show the location of the characteristics more clearly. The following gives the muscular attachments while the diagrams show the location or areas of muscular attachment.

See Pages 21 and 22

The right clavicle, upper surface.

(Spalteholz.)

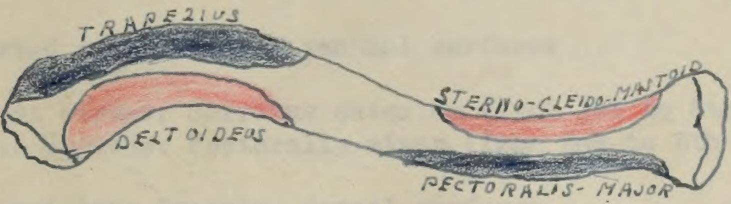


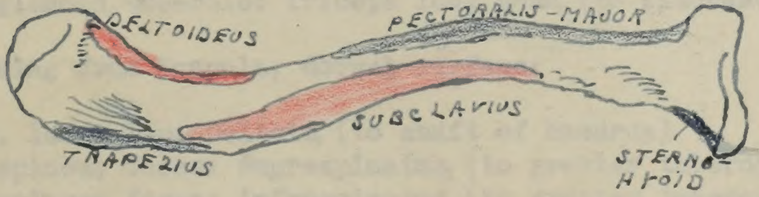


The right clavicle, under surface.

(Spalteholz.)

Areas of muscular attachment, upper surface of right clavicle. (Gerrish.)





Areas of muscular attachment, lower surface of right clavicle. (Gerrish.)

Muscular Attachments of the Scapula:

These muscular attachments may be divided into two groups: those muscles which arise from the trunk and are inserted into the bone, and secondly that group of muscles which arise from the scapula and insert lower down on the humerus or bones of the forearm.

Muscles Inserted into Scapula, ventral surface:

Vertebral border: Serratus anterior, (from 1st to 8th ribs)
Coracoid process: Pectoralis minor, (from 2nd to 5th ribs)

Muscles Inserted into Scapula, dorsal surface:

Vertebral border, above spine: Levator scapulae, (from vertebrae)
below spine: Rhomboids, (from vertebrae)
Spine, upper lip: Trapezius, (from vertebrae and skull)

Muscles Arising from Scapula; ventral surface and glenoid fossa:

Subscapular fossa: Subscapularis, (to lesser tuberosity of humerus)
Coracoid process: Biceps, short head, (to bicipital tubercle of radius). Coracobrachialis, (to shaft of humerus)
Upper border: Omohyoid, posterior belly, (to neck)
Supraglenoid tubercle: Biceps long head, (to bicipital tubercle of radius)
Infraglenoid tubercle: Triceps long head, (to olecranon process of ulna)

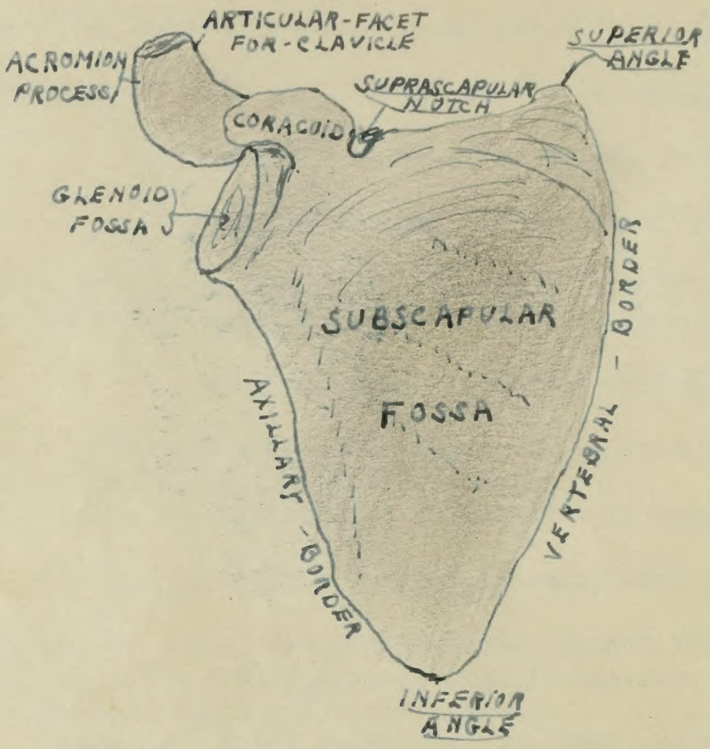
Muscles Arising from Scapula, dorsal surface:

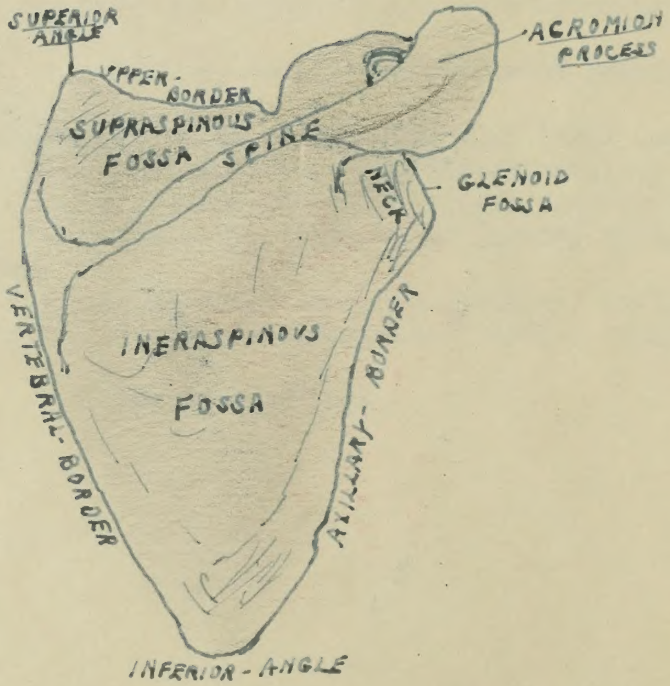
Spine, lower lip: Deltoid, (to shaft of humerus)
Supraspinous fossa: Supraspinatus, (to greater tuberosity of humerus)
Infraspinous fossa: Infraspinatus, (to greater tuberosity of humerus)
Axillary border, upper part: Teres minor; (to greater tuberosity of humerus)
Axillary border, lower end: Teres major, (to bicipital groove of humerus)
Axillary border, tip: Latissimus dorsi, (to bicipital groove of humerus).

See Pages 24 and 25

The right scapula, ventral view.

(Spalteholz.)

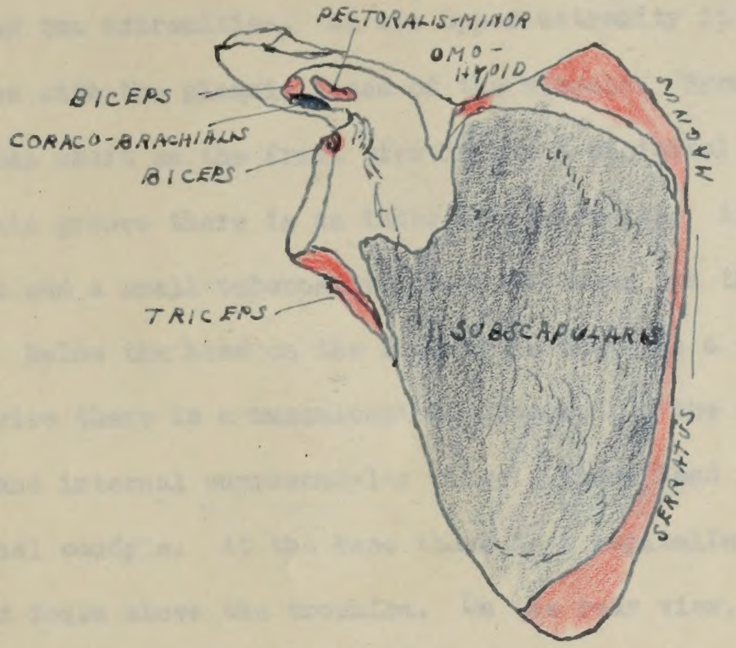


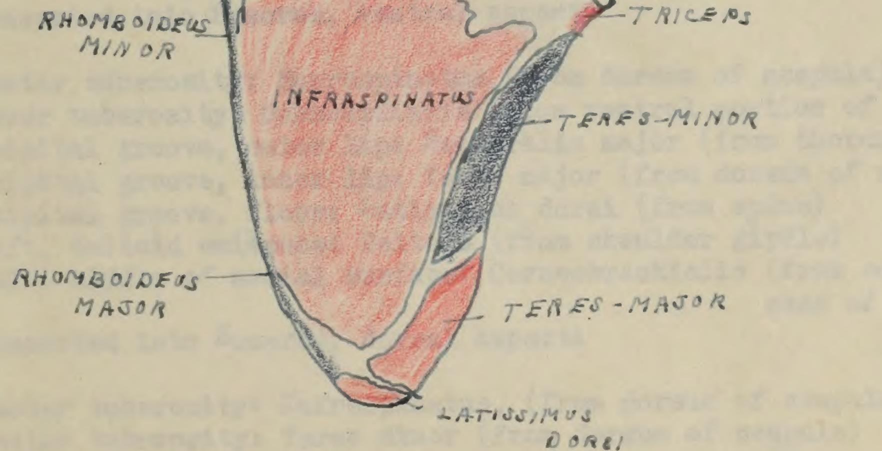


The right scapula, dorsal view.

(Spalteholz.)

Areas of muscular attachment, ventral surface of right scapula. (Gerrish.)





Areas of muscular attachment, dorsal surface of right scapula. (Gerrish.)

The Humerus

The humerus is the longest bone of the upper extremity. It has a shaft and two extremities. At its upper extremity it has a head which articulates with the glenoid fossa of the scapula. From the head extending down the shaft on the front view it has a bicipital groove. On either side of this groove there is an inner and outer lip. At the extreme top is a great and a small tuberosity. Between these two there is an anatomical neck. Below the head on the inner side there is a surgical neck. On the rear view there is a musculospiral groove. On the ventral view an external and internal supracondylar ridge. These lead into an external and internal condyle. At the base there is a capitellum, a trochlea, and a coronoid fossa above the trochlea. On the rear view, above the trochlea is the olecranon fossa. The following will give the muscular attachments and the drawing will show the characteristics and muscular areas.

Muscular Attachments of the Humerus:

The humerus provides insertion for muscles which arise from the trunk and shoulder girdle and gives origin to others which arise from the humerus and inset in the forearm or hand.

Muscles Inserted into Humerus, ventral aspect:

Greater tuberosity: Supraspinatus (from dorsum of scapula)
Lesser tuberosity: Subscapularis (from ventral portion of scapula)
Bicipital groove, outer lip: Pectoralis major (from thorax and clavicle)
Bicipital groove, inner lip: Teres major (from dorsum of scapula)
Bicipital groove, floor: Latissimus dorsi (from spine)
Shaft, deltoid eminence: Deltoid (from shoulder girdle)
Shaft, middle of medial surface: Coracobrachialis (from coracoid process of scapula)

Muscles Inserted into Humerus, dorsal aspect:

Greater tuberosity: Infraspinatus, (from dorsum of scapula)
Greater tuberosity: Teres minor (from dorsum of scapula)

Muscles Arising from Humerus, ventral aspect:

Shaft, lower half: Brachialis (tocoronoid process of ulna)
Shaft, lateral epicondyloid ridge: Brachioradialis (to styloid process of radius)
Shaft, lateral epicondyloid ridge: Extensors of hand (to metacarpals and phalanges)
Shaft, lateral epicondyloid ridge: Extensors carpi radialis longus (to 2nd metacarpal)
Shaft, medial epicondyle: Pronators and flexors of forearm and hand (to radius, metacarpals and phalanges)

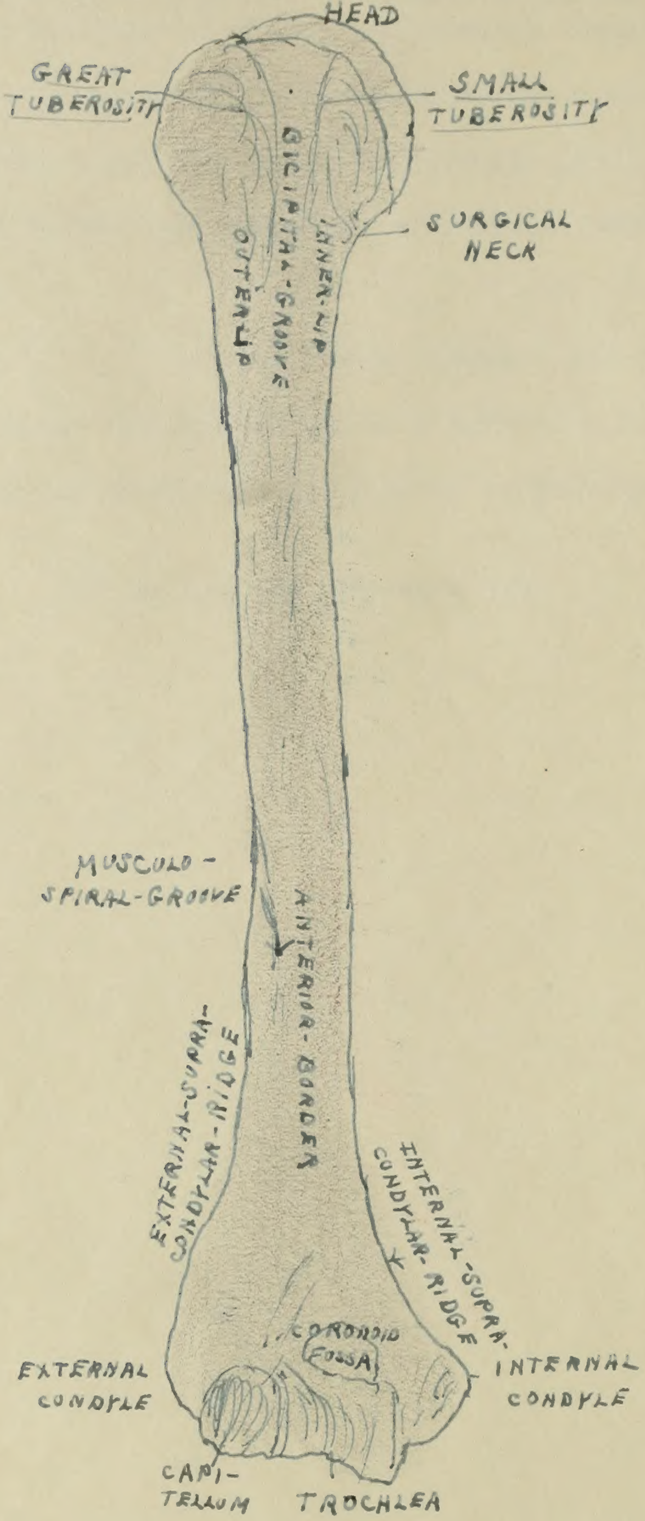
Muscles Arising from Humerus, dorsal aspect:

Shaft, whole surface: Triceps, lateral and medial heads (to olecranon process of ulna)
Lateral epicondyle: anconeus (to olecranon and shaft of ulna).

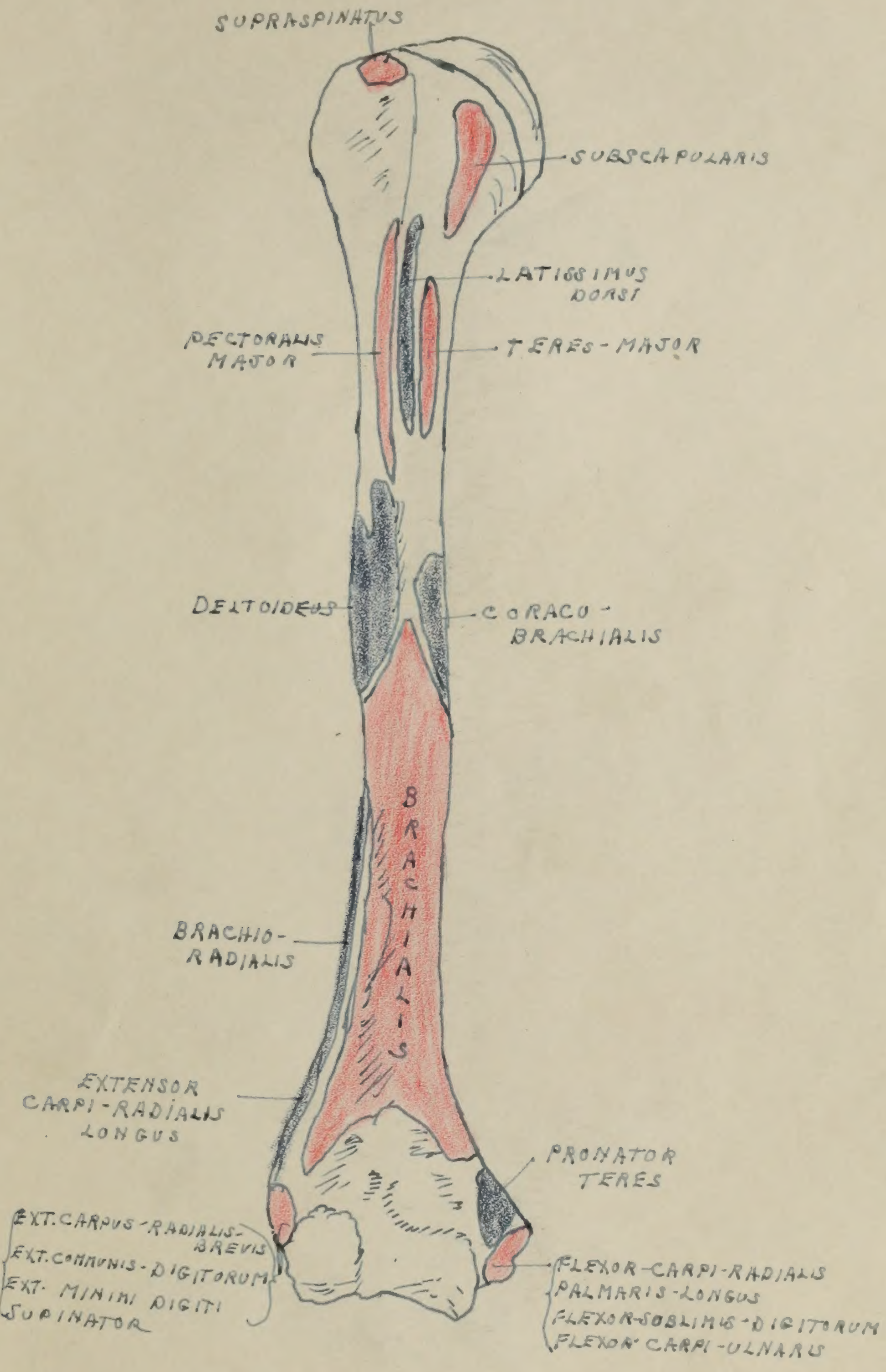
See pages 28, 29, 30, and 31.

The right humerus, front view.

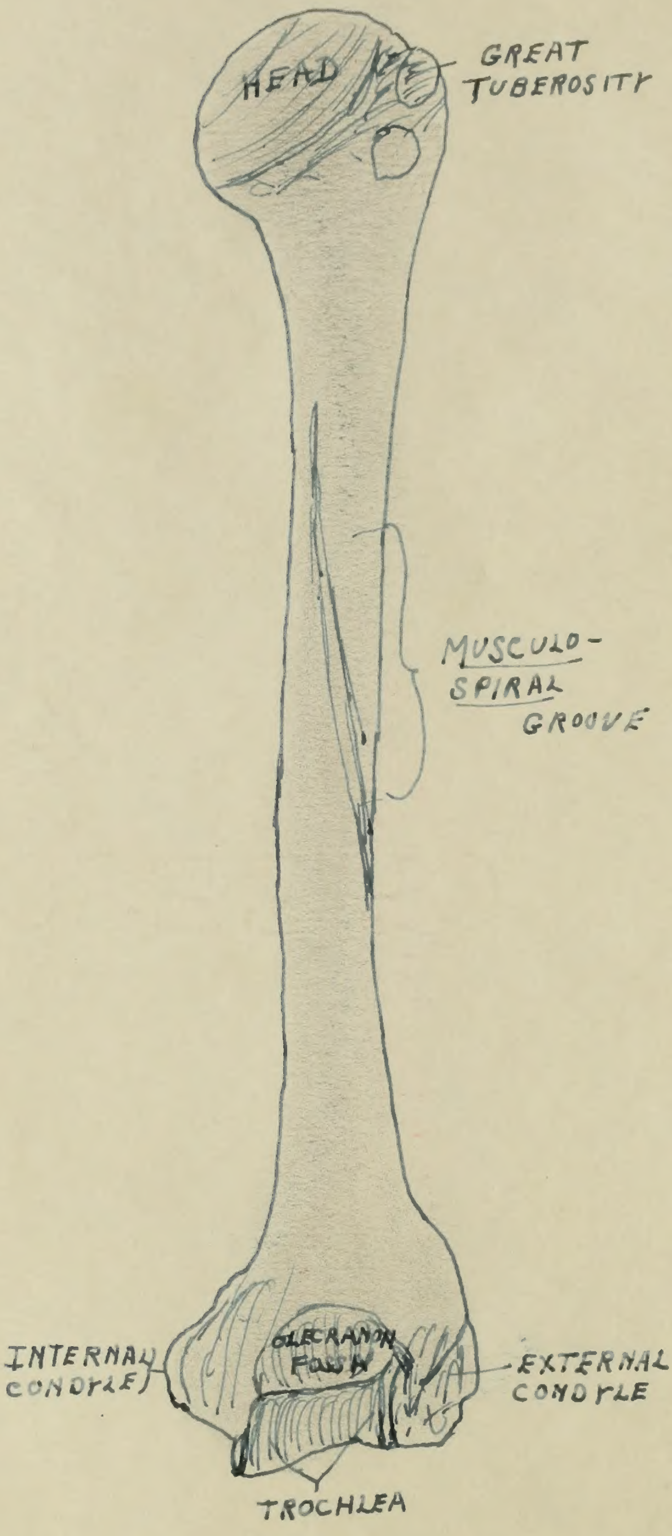
(Testut.)



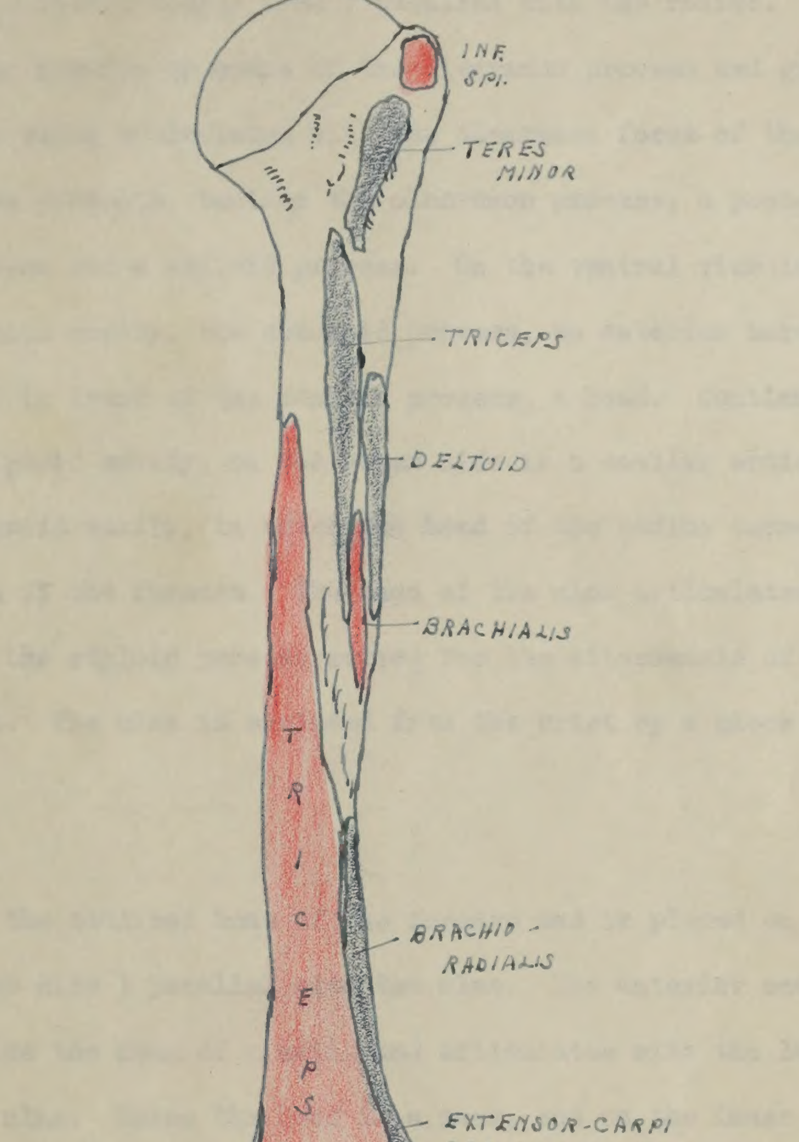
Areas of muscular attachment, ventral aspect of right humerus. (Gerrish.)



The Right Humerus, (rear view)
(Testut)



Areas of muscular attachment, dorsal surface of right humerus. (Gerrish.)



The Ulna

This is the largest bone of the forearm and is placed on the inner side (or little finger side) parallel with the radius. It is attached to the humerus by means of the olecranon process and great sigmoid cavity which articulates with the olecranon fossa of the humerus. The dorsal view presents, besides the olecranon process, a posterior border and at the extreme end a styloid process. On the ventral view is found the great sigmoid cavity, the coronoid process, an anterior border, and at the extreme end in front of the styloid process, a head. Continuous with the greater sigmoid cavity, on the outer side is a smaller articular surface, the lesser sigmoid cavity, in which the head of the radius turns in pronation and supination of the forearm. The head of the ulna articulates with the radius, while the styloid process serves for the attachments of ligaments from the wrist. The ulna is excluded from the wrist by a piece of fibrocartilage.

The Radius

This is the smallest bone of the forearm and is placed on the outer side (or thumb side) parallel with the ulna. The anterior end has a head which looks like the head of a nail, and articulates with the lesser sigmoid cavity of the ulna. Below the head is a neck, and on the inner side near the ulna is found the bicipital tuberosity where the tendon of the biceps muscle attaches. Along the shaft it has a posterior and an anterior border and ends into a styloid process which is larger than that of the ulna and forms the chief part of the wrist. When the hand is in supination, the radius and ulna are parallel, but during pronation the radius crosses over

the ulna. The following page will give the muscular attachments and the drawings will show muscle areas and characteristics.

Muscular Attachments of Radius and Ulna:

The bones of the forearm provide insertion for muscles which arise from the scapula or humerus and act on the radius and ulna. They give origin to muscles which are inserted in the bones of the wrist and fingers, and to two muscles which pass from ulna to radius.

Muscles Inserted into Radius and Ulna, Ventral aspect:

Ulna, coronoid process: Brachialis (from shaft of humerus)
Radius, bicipital tubercle: Bicepts (from scapula)
Radius, neck and antero-lateral surface of shaft: Supinator (brevis) (from ulna)
Radius, shaft, middle of lateral surface: Pronator radii teres (from medial epicondyle of humerus)
Radius, shaft, anterior surface, lower quarter: Pronator quadratus (from ulna)
Radius, styloid process, base: Brachioradialis (from lateral epicondyloid ridge of humerus)

Muscles Inserted into Radius and Ulna, Dorsal aspect:

Ulna, apex of olecranon: Triceps (from scapula and humerus)
Ulna, olecranon and shaft below: Anconeus (from lateral epicondyle of humerus)
Radius, neck and shaft below: Supinator (brevis) (from ulna)

Muscles Arising from Radius and Ulna, Ventral aspect:

Ulna, coronoid process: Pronator radii teres, deep head (to radius)
Ulna, coronoid process: Flexor sublimis digitorum (to middle phalanges, fingers)
Ulna, coronoid process: Flexor longus pollicis (to terminal phalanx of thumb)
Ulna, shaft, below radial notch: Supinator (brevis) (to neck and shaft of radius)
Ulna, shaft, anterior and medial surfaces: Flexor profundus digitorum (to terminal phalanges, fingers)
Ulna, shaft, anterior surface, lower quarter: Pronator quadratus (to radius)
Radius, shaft, anterior aspect: Flexor sublimis digitorum (to middle phalanges of fingers)

Radius, shaft anterior aspect: Flexor longus pollicis (to terminal phalanx of thumb)

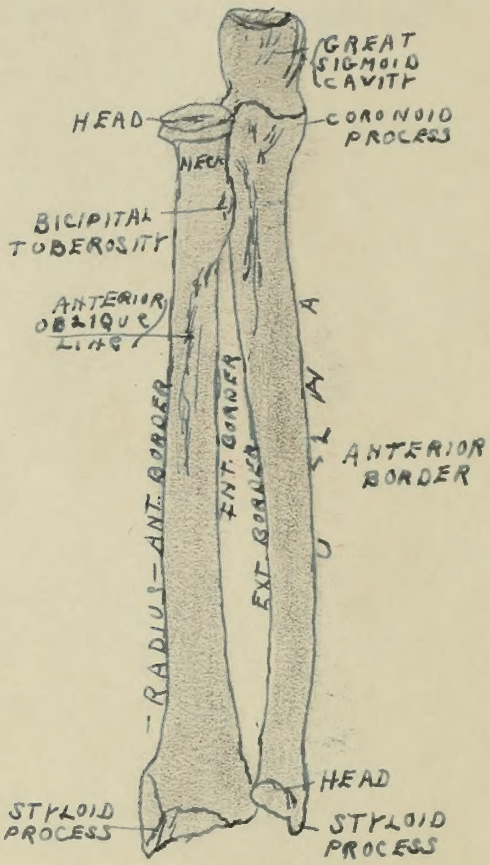
Muscles Arising from Radius and Ulna, Dorsal aspect:

Ulna, shaft: Abductor longus pollicis (to metacarpal of thumb)
Ulna, shaft: Extensor longus pollicis (to terminal phalanx of thumb)
Ulna, shaft: Extensor indicis (to index finger)
Radius, shaft: Abductor longus pollicis (to metacarpal of thumb)
Radius, shaft: Extensor brevis pollicis (to proximal phalanx of thumb)

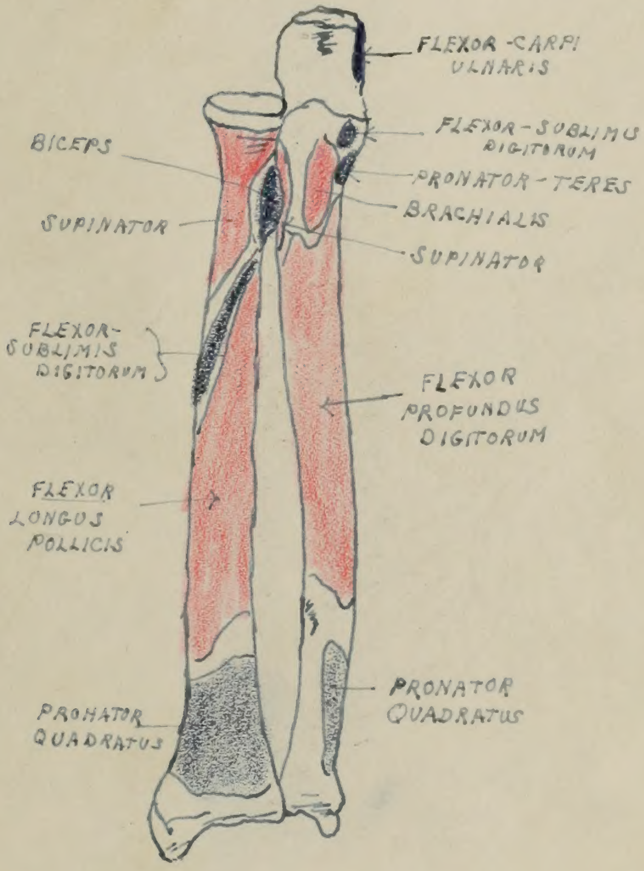
See Pages 35, 36, 37, and 38.

The bones of the right forearm, ventral view.

(Testut.)

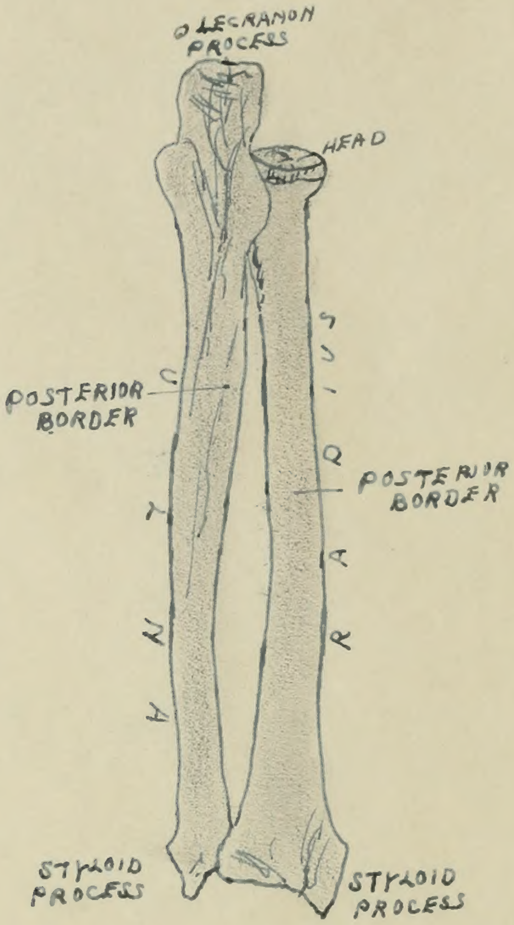


Areas of muscular attachment, ventral aspect of the radius and ulna. (Gerrish.)

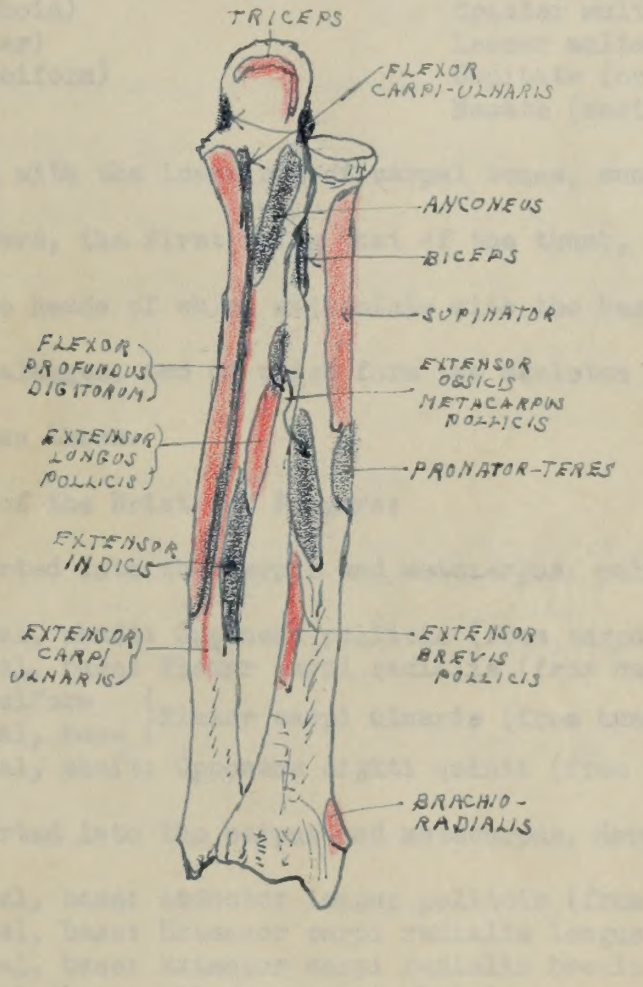


The bones of the right forearm, dorsal view.

(Testut.)



Areas of muscular attachment, dorsal aspect of radius and ulna. (Gerrish.)



The Bones of the Hand

They consist of eight carpal bones, five metacarpal bones, and fourteen phalanges. The carpal bones are arranged in two rows, named from the radial side inward.

Upper row	Lower row
Navicular (scaphoid)	Greater multangular (trapezium)
Lunate (semilunar)	Lesser multangular (trapezoid)
Triangular (cuneiform)	Capitate (os magnum)
Pisiform	Hamate (unciform)

Articulating with the lower row of carpal bones, numbered from the radial side inward, the first being that of the thumb, are the five metacarpal bones the heads of which articulate with the bases of the first row of the phalanges, two of which form the skeleton of the thumb, while each finger has three.

Muscle Attachments of the Wrist and Fingers:

Muscles inserted into the carpus and metacarpus, palmar surface

1st metacarpal, shaft: Opponens pollicis (from carpus, radial side)
2nd metacarpal, base: Flexor carpi radialis (from humerus)
Pisiform, unciform (
5th metacarpal, base (Flexor carpi ulnaris (from humerus & ulna)
5th metacarpal, shaft: Opponens digiti quinti (from carpus, ulnar side)

Muscles inserted into the carpus and metacarpus, dorsal surface

1st metacarpal, base: Abductor longus pollicis (from radius and ulna)
2nd metacarpal, base: Extensor carpi radialis longus
3rd metacarpal, base: Extensor carpi radialis brevis
4th metacarpal, base: Extensor carpi ulnaris
(2, 3, 4, from lateral supracondyloid ridge and epicondyle of humerus)

Muscles arising from carpus and metacarpus, palmar surface

Carpus, radial side: Abductor pollicis brevis (to 1st phalanx)
Carpus, radial side: Flexor pollicis brevis (thumb, base)
Carpus, radial side: Opponens pollicis (to 1st metacarpal shaft)

Carpus, 2nd row: 2nd & (Adductor pollicis (to 1st phalanx of
3rd metacarpal: (thumb, base).
Carpus, ulnar side: Abductor digiti quinti (to 1st phalanx, little)
Carpus, ulnar side: Flexor brevis digiti quinti (finger, base)
Carpus, ulnar side: Opponens digiti quinti, (to 5th metacarpal shaft)
2nd, 4th, and 5th metacarpals: Palmar Interossei (to 1st phalanges,
base, 2nd, 4th, and 5th fingers)

Muscles arising from carpus and metacarpus, posterior surface.
All metacarpals: Dorsal interossei (to 1st phalanges, base, 2nd, 3rd,
4th fingers)

Muscles inserted into phalanges, palmar surface

Proximal phalanx of thumb: Abductor pollicis brevis (from carpus)
Proximal phalanx of thumb: Flexor pollicis brevis (radial side)
Proximal phalanx of thumb: Adductor pollicis (from carpus, 2nd row; 2nd
& 3rd metacarpal)
Proximal phalanx of 5th finger: Abductor digiti quinti (from carpus)
Proximal phalanx of 5th finger: Flexor brevis digiti quinti (ulnar side)
Middle phalanges: Flexor sublimis digitorum (from humerus, ulna, and radius)
Terminal phalanx of thumb: Flexor longus pollicis (from radius)
Terminal phalanges of fingers: Flexor profundus digitorum (from ulna)

Muscles inserted into phalanges, dorsal surface

Proximal phalanx of thumb: Extensor pollicis brevis (from radius)
Proximal phalanges of fingers, dorso-lateral surface:
    Lumbricales (from flexor profundus digitorum)
    Palmar Interossei (from 2nd, 4th, and 5th metacarpals)
    Dorsal interossei (from all metacarpals)
Middle and terminal phalanges of fingers:
    Extensor communis digitorum (from external epicondyle of humerus)
    Extensor minimi digiti
    Extensor indicis (from ulna)
Terminal phalanx of thumb: Extensor pollicis longus (from ulna)

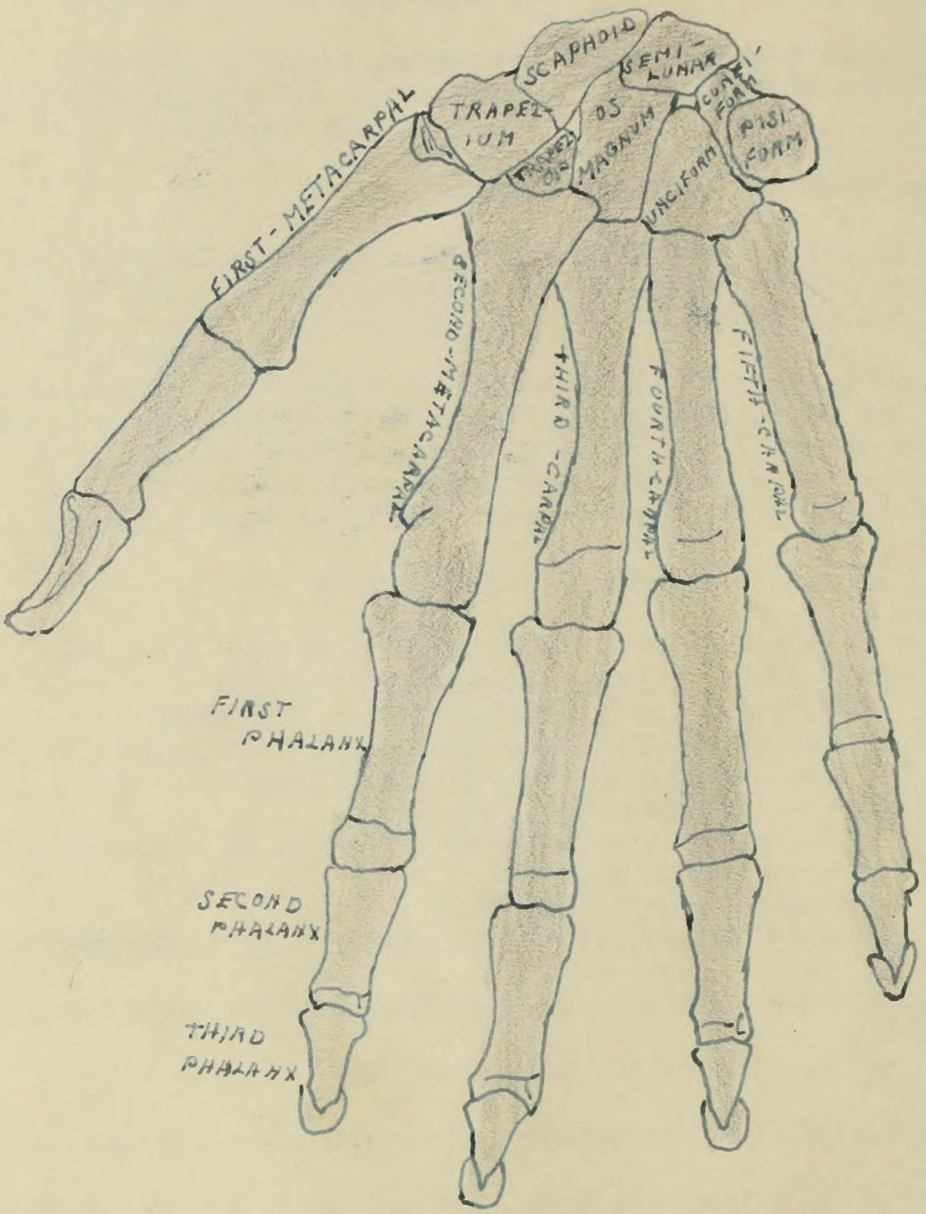
The following drawings will show the muscular area covered on the bones, and the location of the bones themselves.

The long flexors and extensor muscles of the wrist and fingers arise from the humerus, radius, and ulna. The muscles acting on the wrist are inserted into the second row of the carpus and the base of the metacarpal bones; the muscles acting on the fingers are inserted into the middle and terminal phalanges. The short flexors and extensors and the adductors and abductors of the thumb and fingers arise from the carpal bones and metacarpal bones are inserted chiefly into the proximal phalanges.

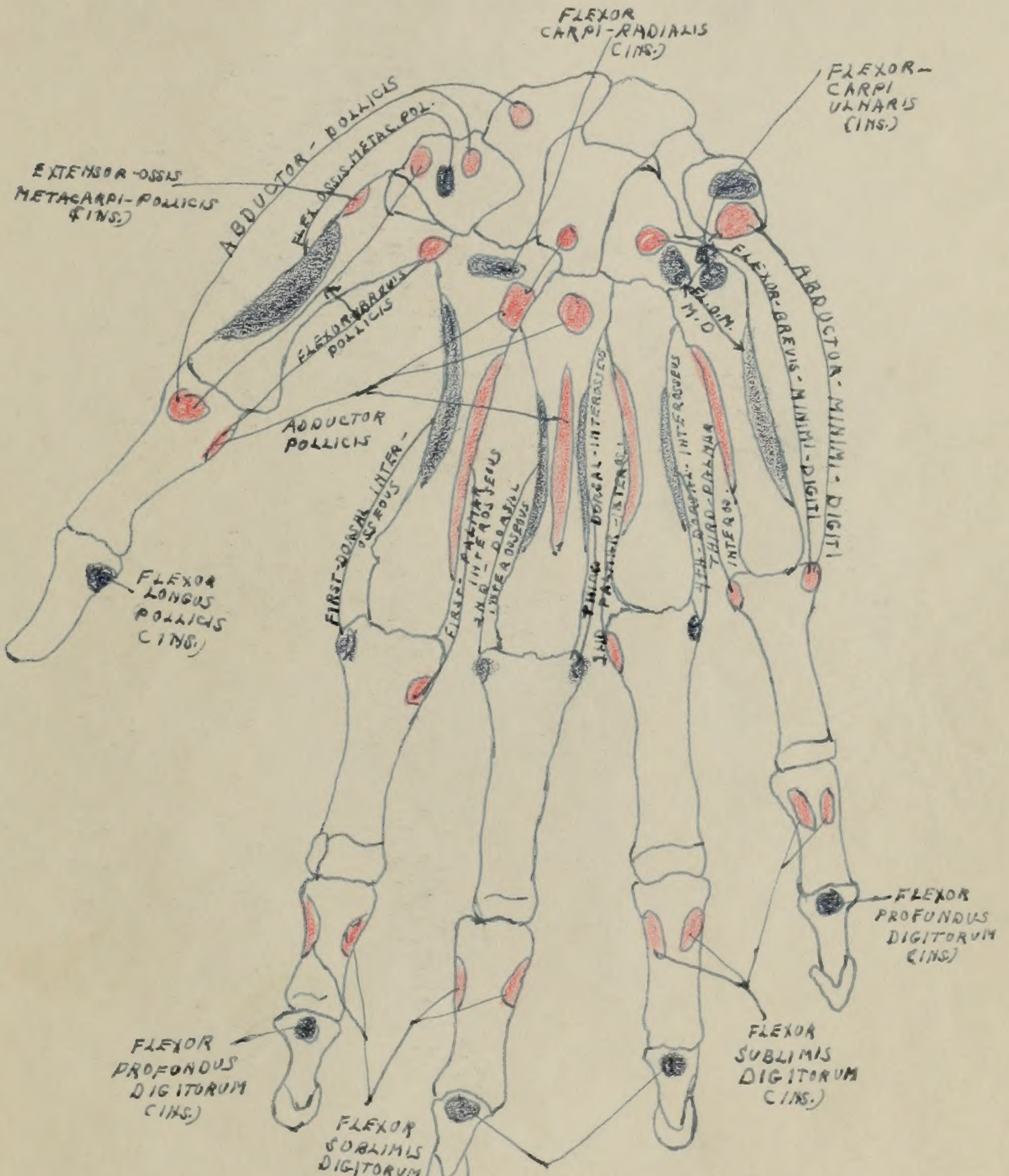
See pages 41, 42, 43, 44.

The bones of the right hand, palmar aspect.

(Spalteholz.)

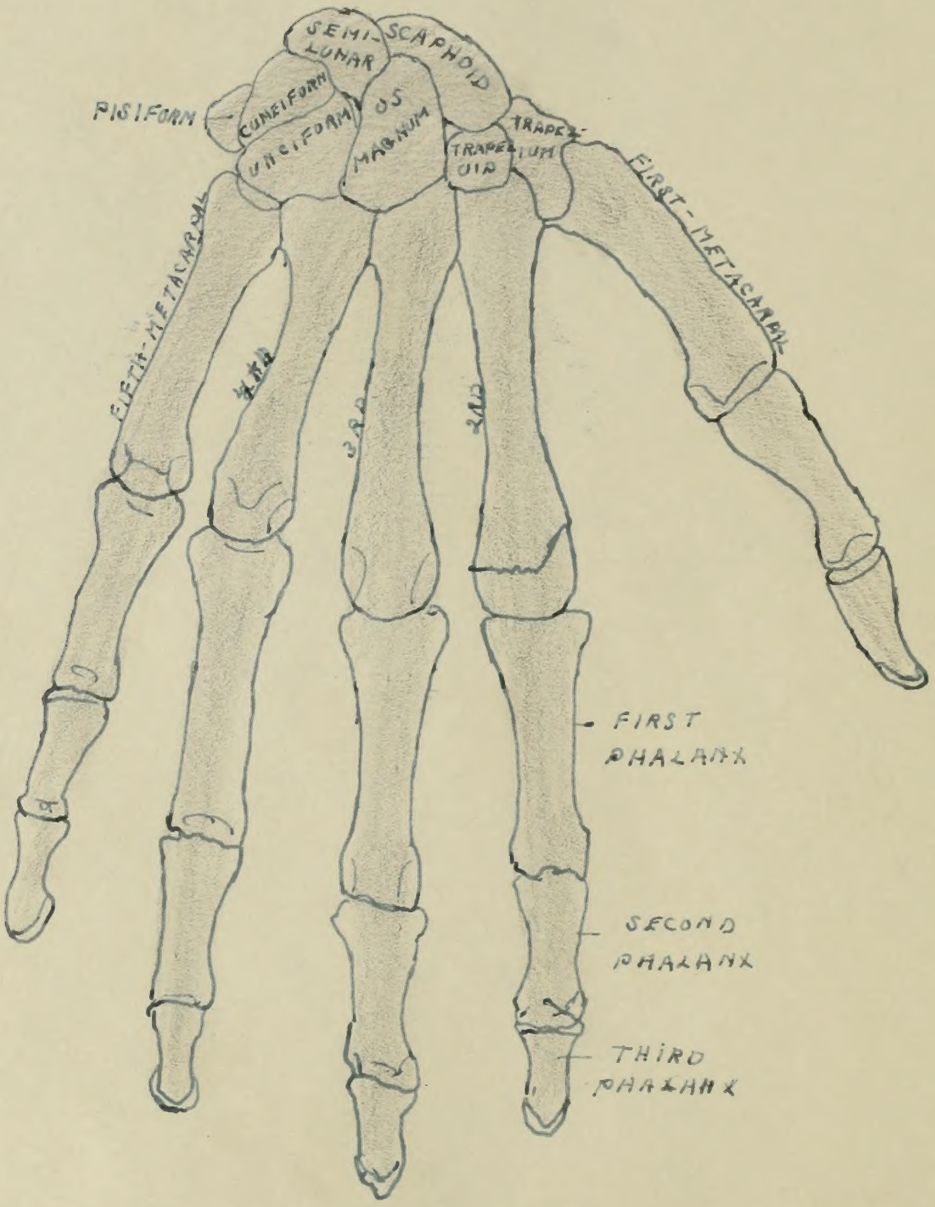


Areas of muscular attachment on the palmar surface of the bones of the hand. Where the areas of origin and insertion are both presented they are in the same color. INS., insertion FL.O.M.MD., flexor ossis metacarpi minimi digiti. (Gerrish.)

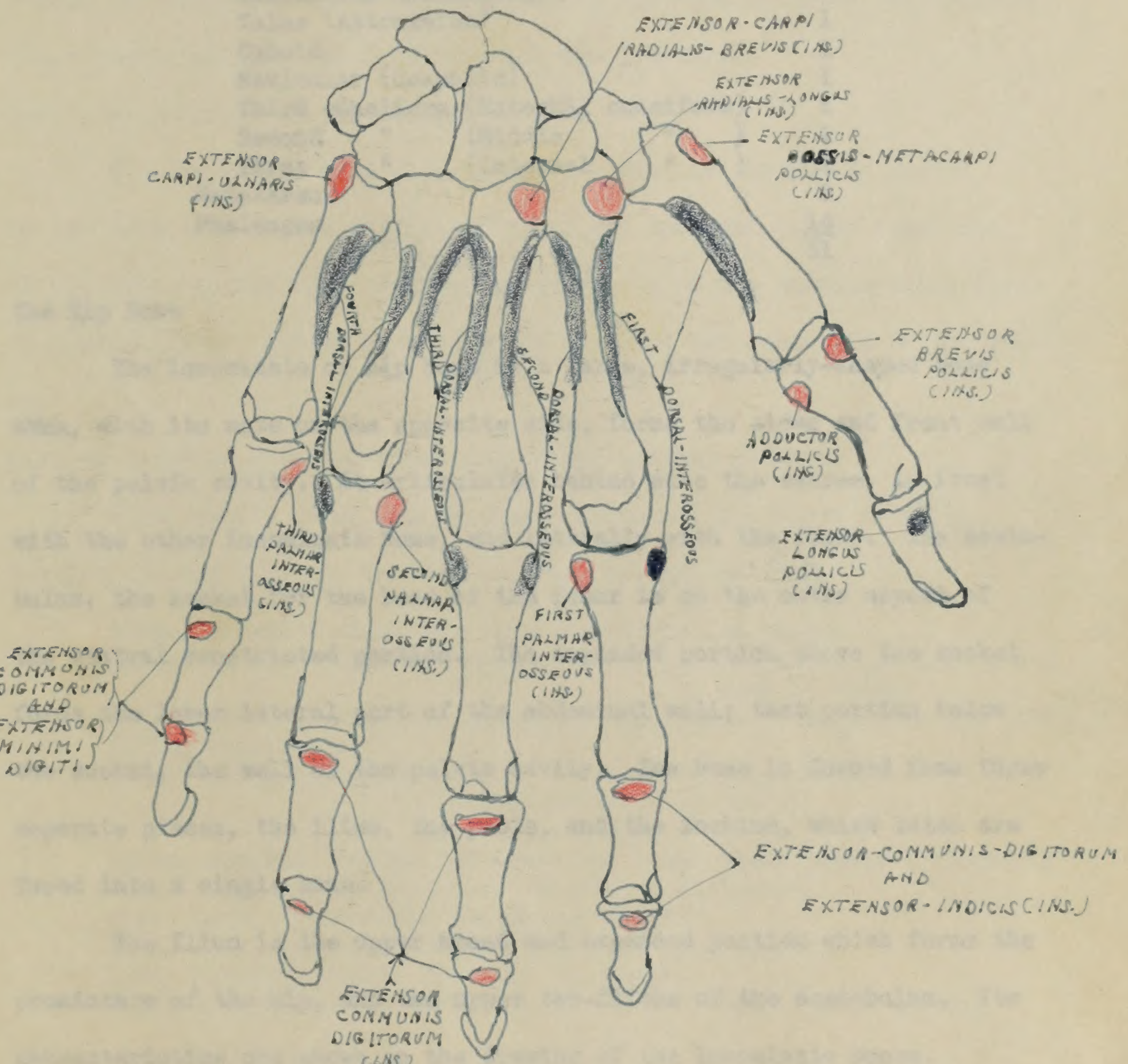

FLEXOR CARPI-RADIALIS (INS.)
FLEXOR-CARPI ULNARIS (INS.)
ABDUCTOR-POLLICIS
FLEX OSSIS METAC. POL.
EXTENSOR-OSSIS METACARPI-POLLICIS (INS.)
FLEXOR BREVIS POLLICIS
ADDUCTOR POLLICIS
FIRST-DORSAL INTER-OSSEOUS
FIRST-PALMAR INTEROSSEOUS
2ND-DORSAL INTEROSSEOUS
THIRD PALMAR
DORSAL-INTEROSSEOUS
2ND
INTEROSSEOUS
4TH-DORSAL-INTEROSSEOUS
THIRD-PALMAR INTERO.
FL.O.M. M.D
FLEXOR-BREVIS-MINIMI-DIGITI
ABDUCTOR-MINIMI-DIGITI
FLEXOR LONGUS POLLICIS (INS.)
FLEXOR PROFUNDUS DIGITORUM (INS.)
FLEXOR SUBLIMIS DIGITORUM (INS.)
FLEXOR PROFUNDUS DIGITORUM (INS.)
FLEXOR SUBLIMIS DIGITORUM (INS.)
FLEXOR PROFUNDUS DIGITORUM (INS.)

The bones of the right hand, dorsal aspect.

(Spalteholz.)



Areas of muscular attachment on the dorsal surface of the bones of the hand. Where the areas of origin and insertion are both presented, they are in the same color. (Gerrish.)


EXTENSOR-CARPI RADIALIS-BREVIS (INS.)
EXTENSOR RADIALIS-LONGUS (INS.)
EXTENSOR OSSIS-METACARPI POLLICIS (INS.)
EXTENSOR CARPI-ULNARIS (INS.)
FOURTH DORSAL-INTEROSSEOUS
THIRD DORSAL-INTEROSSEOUS
SECOND DORSAL-INTEROSSEOUS
FIRST DORSAL-INTEROSSEOUS
EXTENSOR BREVIS POLLICIS (INS.)
ADDUCTOR POLLICIS (INS.)
EXTENSOR LONGUS POLLICIS (INS.)
THIRD PALMAR INTER-OSSEOUS (INS.)
SECOND PALMAR INTER-OSSEOUS (INS.)
FIRST PALMAR INTER-OSSEOUS (INS.)
EXTENSOR COMMUNIS DIGITORUM AND EXTENSOR MINIMI DIGITI
EXTENSOR-COMMUNIS-DIGITORUM AND EXTENSOR-INDICIS (INS.)
EXTENSOR COMMUNIS DIGITORUM (INS.)

The Bones of the Lower Extremity

Hip Bone	1
Femur	1
Patella (A sesamoid bone)	1
Tibia	1
Fibula	1
Tarsus	
Calcaneous (Calcaneum)	1
Talus (Astragalus)	1
Cuboid	1
Navicular (Scaphoid)	1
Third cuneiform (External cuneiform)	1
Second " (Middle ")	1
First " (Internal ")	1
Metatarsus	5
Phalanges	14
	31

The Hip Bone

The innominate or hip bone is a large, irregularly-shaped bone which, with its mate on the opposite side, forms the sides and front wall of the pelvic cavity. It articulates behind with the sacrum, in front with the other innominate bone, and laterally with the femur. The acetabulum, the socket for the head of the femur is on the outer aspect of the central constricted portion. The expanded portion above the socket forms the lower lateral part of the abdominal wall; that portion below the socket, the wall of the pelvic cavity. The bone is formed from three separate pieces, the ilium, the pubis, and the ischium, which later are fused into a single bone.

The Ilium is the upper broad and expanded portion which forms the prominence of the hip, and the upper two-fifths of the acetabulum. Its characteristics are shown on the drawing of the Innominate bones.

The Pubis forms the anterior wall of the pelvic cavity and consists of the flattened body and two rami. The medial border of the body forms

the pubis symphysis with the opposite bone. The pubis forms the anterior fifth of the acetabulum.

The Ischium forms the inferior portion of the hip bone and forms about two-fifths of the acetabulum. The body of the bone is thick and strong and bears below a rough projection, the tuberosity of the ischium. Other characteristics will be shown on the drawings.

Muscle Attachments of the Innominate Bone

The innominate bone gives origin to muscles which pass upward to the trunk and to the shoulder girdle, and downward to the femur and to the bones of the leg. It also gives origin to the muscles which form the pelvic floor, and to muscles which surround the genitalia in the perineum.

Muscles inserted into the innominate bone, lateral surface.

Iliac crest, outer lip: External oblique (from lower ribs)

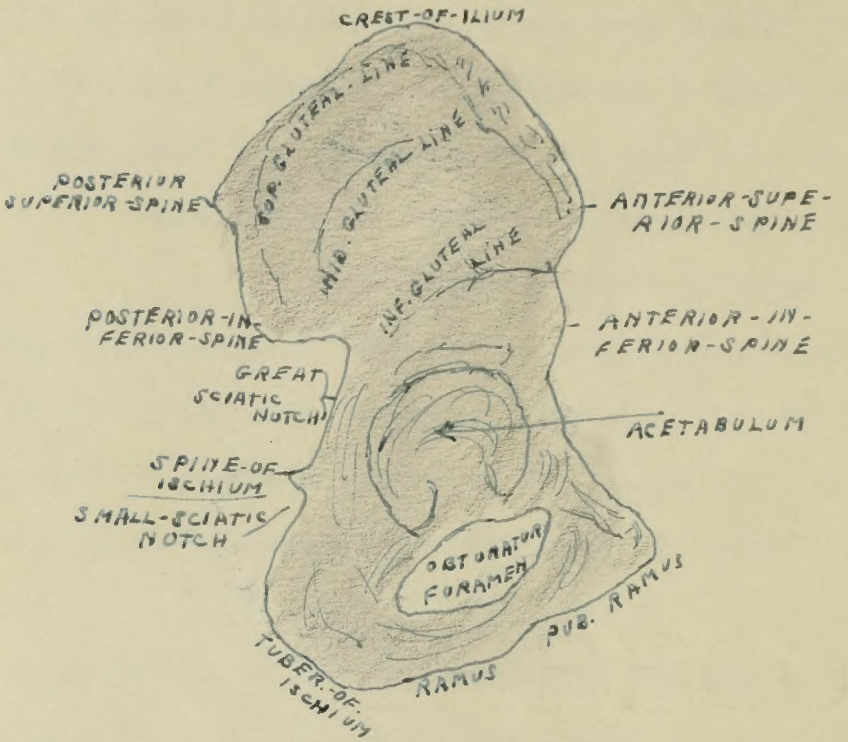
Muscles arising from the innominate bone, lateral surface.

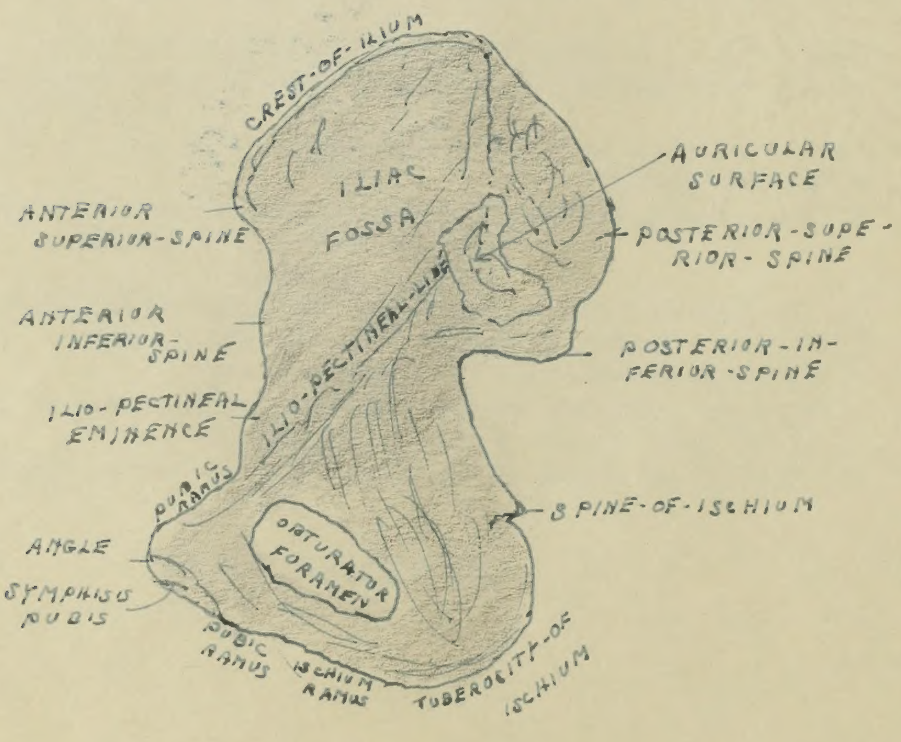
Ilium, anterior superior spine: Sartorius (to tibia)
Ilium, anterior superior spine: Tensor fasciae latae (to iliotibial band of thigh)
Ilium, anterior inferior spine: Rectus femoris (to patella and tibia)
Ilium, acetabulum:
Ilium, gluteal ridges: Gluteus maximum (to great trochanter)
Gluteus medius (of femur)
Gluteus minimus
Pubis, superior ramus: Pectineus (to femur below lesser trochanter)
Pubis body, Rectus abdominis (to ribs and xiphoid)
Pubis body, Pyramidalis (to rectus sheath)
Pubis body, Adductor longus (to femus, linea aspera)
Pubis inferior ramus: Gracilis (to tibia)
Pubis inferior ramus: Adductor brevis (to femur, linea aspera)

See Pages 47, and 48.

The right hip-bone, outer surface.

(Testut.)

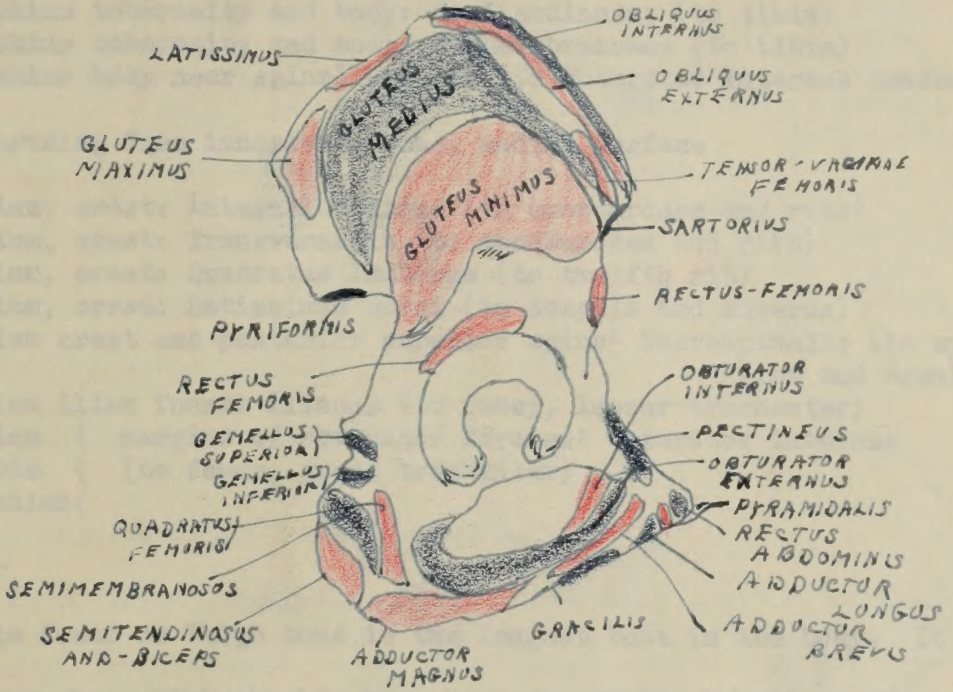


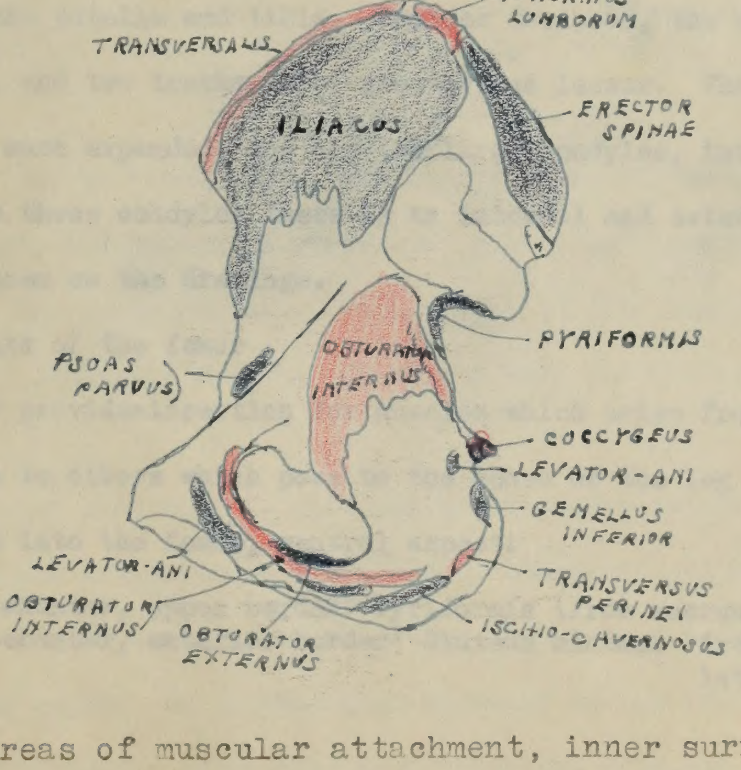


The right hip-bone, inner surface.

(Testut.)

Areas of muscular attachment, outer surface of right hip-bone. (Testut.)





Areas of muscular attachment, inner surface of right hip-bone. (Testut.)

Ischium, superior ramus: Adductor magnus (to femur, linea aspera)
Ischium, tuberosity: Obturator externus (to femur, great trochanter)
Ischium tuberosity and body: Quadratus femoris (to femur, great ")
Ischium tuberosity and body: Biceps (to fibula)
Ischium tuberosity and body: Semitendinosus (to tibia)
Ischium tuberosity and body: Semimembranosus (to tibia)
Ischium body near spine: Gemelli (to obturator internus tendon)

Muscles arising from innominate bone, medial surface

Ilium, crest: Internal oblique (to aponeuroses and ribs)
Ilium, crest: Transversalis (to aponeuroses and ribs)
Ilium, crest: Quadratus lumborum (to twelfth rib)
Ilium, crest: Latissimus dorsi (to scapula and humerus)
Ilium crest and posterior superior spine: Sacrospinalis (to spine, ribs and cranium)
Ilium iliac fossa: Iliacus (to femur, lesser trochanter)
Ilium (margins of obturator foramen: Obturator internus
Pubis ((to femur, great trochanter)
Ischium(

The Femur

The Femur or Thigh bone is the longest bone in the body. It articulates above with the hip bone by means of the head into the acetabulum, and below with the patella and tibia. Besides the head, the upper extremity presents a neck, and two trochanters, greater and lesser. The lower extremity of the femur is much expanded, and has two large condyles, internal and external. Above these condyles there is an internal and external tuberosity. These will be shown on the drawings.

Muscle attachments of the femur

The femur providesinsertion for muscles which arise from the pelvis and gives origin to others which pass to the bones of the leg and foot.

Muscles inserted into the femur, ventral aspect:

Great trochanter, upper border: Pyriformis (from sacrum)
Great trochanter, anterior border: Gluteus minimus (from ilium, lateral surface)

Muscles inserted into the femur, dorsal aspect.

Great trochanter, upper border: Obturator internus (from innominate)
Great trochanter, medial side: Obturator externus (bone obturator foramen)
Great trochanter, lateral side: Gluteus medius (from ilium)
Great trochanter, gluteal ridge: Gluteus maximus (lateral surface)
Great trochanter, intertrochanteric ridge: Quadratus femoris (from ischium)
Lesser trochanter: Iliopsoas (from spine and ilium)
Shaft below lesser trochanter: Pectineus (from pubis)
Shaft linea aspera, inner lip, upper part: adductor brevis (from pubis)
Shaft linea aspera, inner lip, middle part: adductor longus
Shaft linea aspera, inner lip, whole length: Adductor magnus (ischium)

Muscles arising from the femur, ventral aspect

Shaft, front and sides: Vastus lateralis (to patella)
Vastus medialis (and)
Vastus intermedius (tibia)

Muscles arising from the femur, dorsal aspect

Shaft, linea aspera, inner lip: Vastus medialis (to patella)
Shaft, linea aspera, outer lip: Vastus lateralis (and tibia)
Shaft, linea aspera, outer lip: Biceps, short head (to fibula)
Inner condyle, upper surface: Gastrocnemius (to os calcis)
Outer condyle, upper surface: Gastrocnemius (to os calcis)
Outer condyle, upper surface: Plantaris (to os calcis)
Outer condyle, lateral surface: Popliteus (to tibia)

The Patella

The Patella, or knee-cap, is the largest sesamoid bone in the body. It is small, flat, triangular in shape, and placed in front of the knee-joint, which it serves to protect. It articulates with the two condyles of the femur and is separated from the skin by a bursa (a fluid-filled sac).

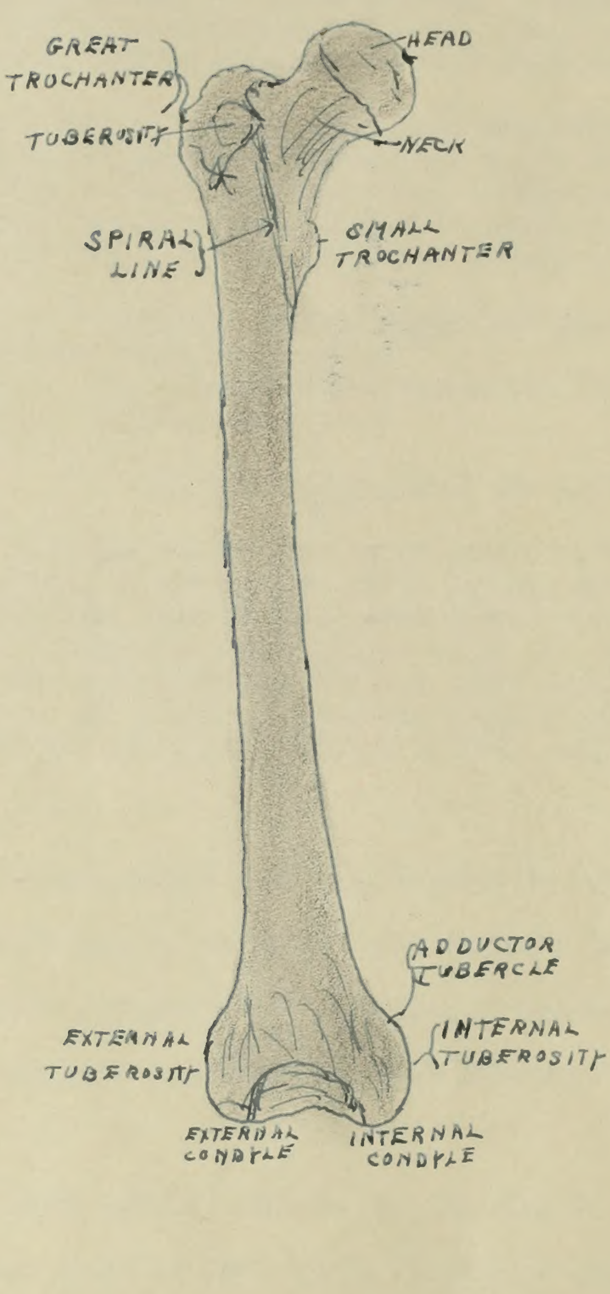
The Tibia

The Tibia or shin bone is situated at the front and inner side of the leg. The upper extremity of the tibia is thick and expanded to give a solid support to the condyles of the femur. The lower extremity is much smaller than the upper. It is prolonged downward on its inner side into a strong process, the inner malleolus; it articulates with the fibula and talus.

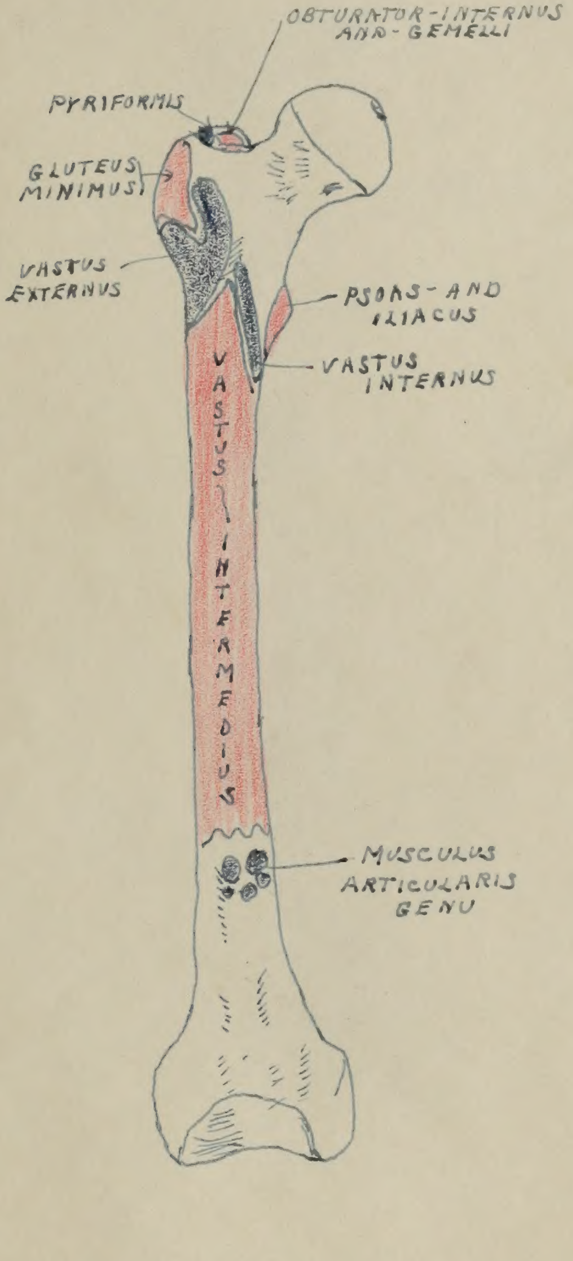
See Pages 51, 52, 53, and 54.

The right femur, front view.

(Testut.)

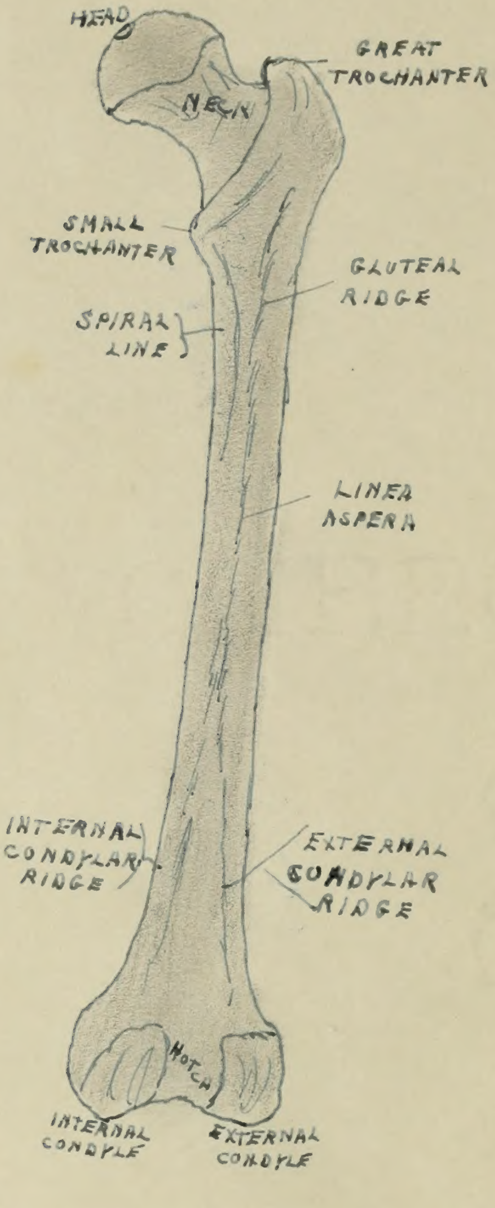


Areas of muscular attachment, ventral surface of right femur. (Gerrish.)

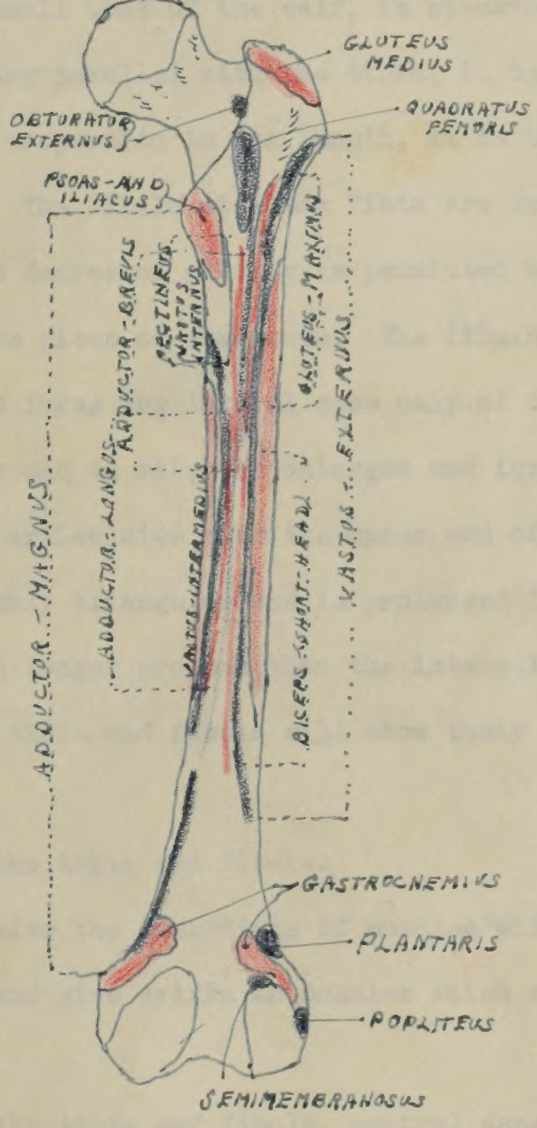


The right femur, rear view.

(Testut.)



Areas of muscular attachment, dorsal aspect of right femur. (Gerrish.)



The Tibia carries practically all the weight of the body and forms the knee joint with the femur and the greater part of the socket of the ankle joint.

The Fibula

The Fibula, or small bone of the calf, is situated at the outer side of the leg. Running parallel with the tibia, it is the smaller of the two bones, and, in proportion to its length, it is the most slender of all the long bones. The Fibula with the Tibia are so firmly united that only a very slight degree of gliding is permitted between them, and they are regarded as one piece of structure. The fibula does not enter into the knee joint and forms the lateral side only of the socket for the ankle joint. The upper end is slightly enlarged and forms the head, which with its under surface articulates with the upper end of the tibia. The lower extremity is roughly triangular and is prolonged into the external malleolus, a larger and longer process than the internal malleolus of the tibia. Drawings of the tibia and fibula will show their characteristics and muscular areas.

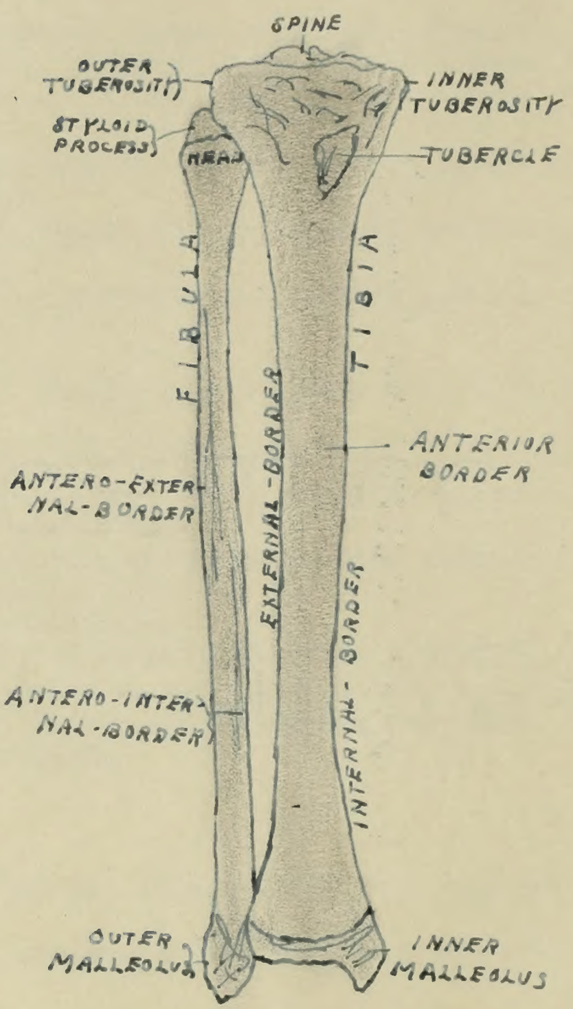
Muscle Attachments of the tibia and fibula.

These bones receive the insertions of muscles which arise from the pelvis and femur, and give origin to muscles which are inserted into the bones of the foot.

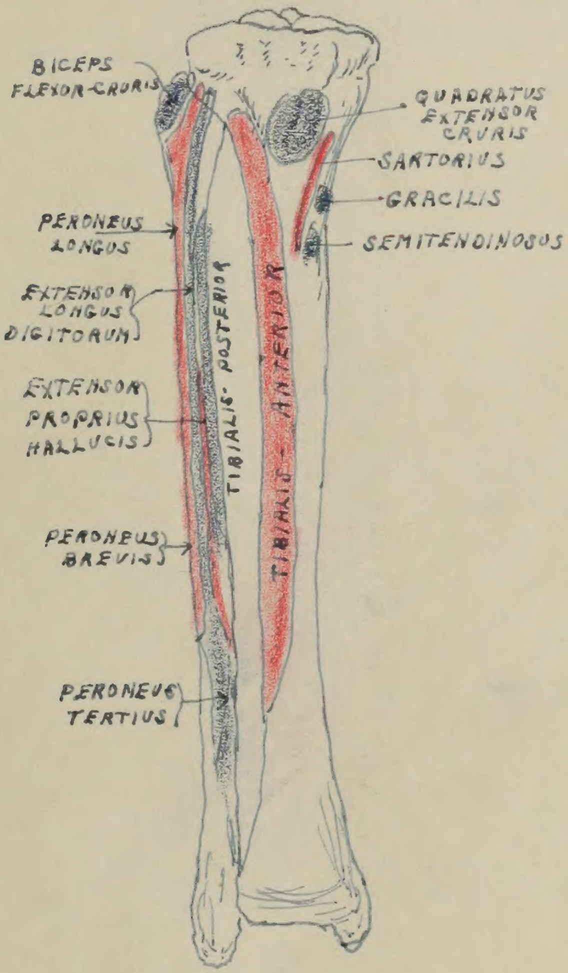
Muscles inserted into the tibia and fibula, ventral aspect.

Tibia tuberosity: Quadriceps extensor (from ilium and femur)
Shaft, below medial condyle: Sartorius (from ilium)
Shaft, below medial condyle: Gracilis (from pubis)
Shaft, below medial condyle: Semitendinosus (from ischium)
Fibula, head and styloid process: Biceps (from ischium and femur)

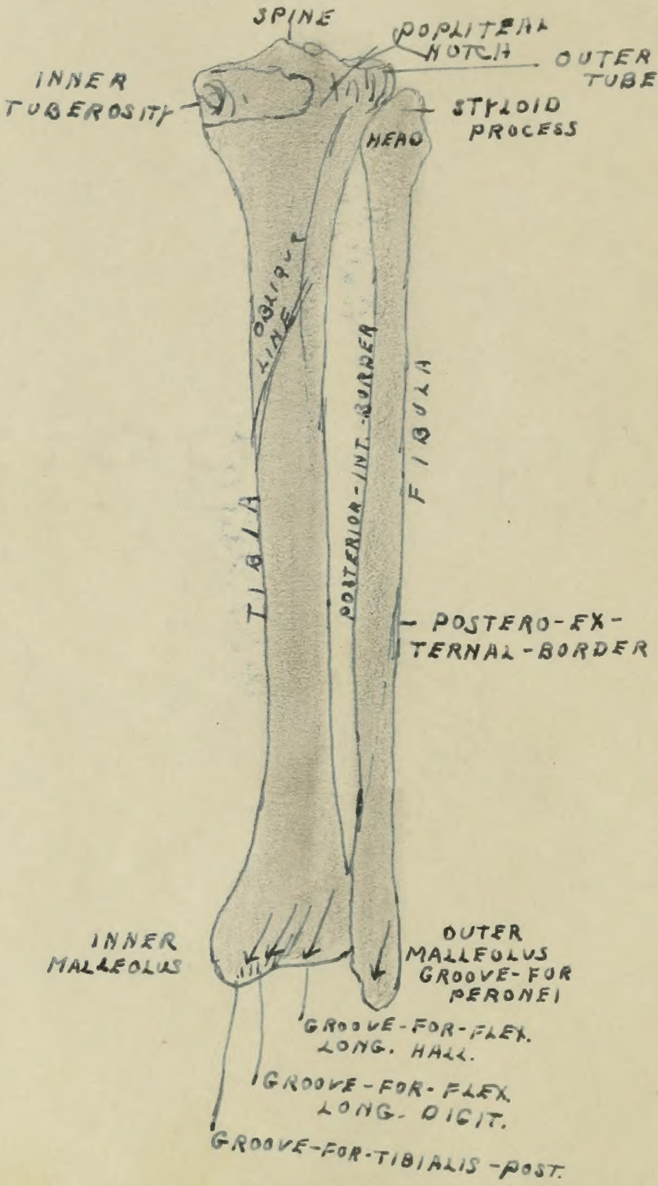
The right tibia and fibula in their normal relations, front view. (Testut.)



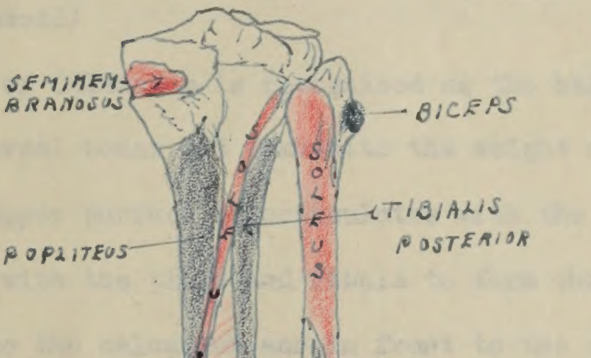
Areas of muscular attachment, anterior aspect of the tibia and fibula. (Gerrish.)



The right tibia and fibula in their normal relations, rear view. (Testut.)



Areas of muscular attachment, posterior aspect of the tibia and fibula. (Gerrish.)



The tarsus is composed of seven bones united by ligaments, and differ from the carpus in being larger and more irregularly shaped. From behind forward, then from outer to inner side, the bones are as follows:
(Drawings will show arrangement)

1 Calcaneus (Calcaneum)
1 Talus (Astragalus)
1 Cuboid
1 Navicular (Scaphoid)

1 Third cuneiform (External cuneiform)
1 Second " (Middle ")
1 First " (Internal ")

The Calcaneus or Calcaneum is recognized as the heel bone and is the largest of the tarsal bones and transmits the weight of the body to the ground. On its upper surface it articulates with the Astragalus (Talus) which unites with the tibia and fibula to form the ankle-joint. Behind it is joined to the calcaneum and in front to the scaphoid.

The Cuboid is in front of the calcaneum and on the outer side of the foot. In front it articulates with the fourth and fifth metatarsals.

The Scaphoid is placed on the inner side in front of the astragalus with which it articulates, as well as with the cuboid, the internal, middle, and external cuneiforms.

The cuneiform bones are in front of the scaphoid and articulate with each other, the scaphoid, the cuboid, and all the metatarsals with the exception of the fifth.

The Metatarsus, or sole and instep of the foot.

The metatarsus is formed by five bones which closely resemble the metacarpal bones of the hand. Each bone articulates with the tarsal bones by one extremity, and by the other with the first row of phalanges. That of the great toe is much heavier than the others, and the fifth or the metatarsal of the little toe is the longest, with a prominent tubercle at its upper end.

The Phalanges

The Phalanges or digits are fourteen in number. Two for the big toe and three for all the others. They are similar to those of the hand, but much shorter.

Muscular attachments of the foot.

The long flexor and extensor muscles of the ankle arise from the tibia and fibula and are inserted into the tarsal bones (except the astragalus, which has no muscle attachments) and into the bases of the metatarsal bones. The long flexors and extensors of the toes arise from the bones of the leg and are inserted into the base of the terminal phalanges of the toes (flexors), and to all three phalanges (extensors). The short flexors and extensors, the adductors and abductors of the toes arise from the tarsal and metatarsal bones and are inserted into the bases of the proximal and middle phalanges of the toes.

Muscles inserted into the foot, dorsal aspect.

Tarsus:

Os calcis, posterior surface, tendo achillis:
Gastrocnemius (from femur)
Plantaris (from femur)
Soleus (from tibia and fibula)

Metatarsus:

5th metatarsal, base: Peroneus brevis (from fibula)
5th metatarsal, base: Peroneus tertius (from fibula)

Phalanges:

Big toe, 1st phalanx, base: Extensor brevis digitorum (from os calsis, dorsal surface)
2nd, 3rd, and 4th toes, 1st phalanges, base: Dorsal interossei (from 1st to 5th metatarsals, shafts)
2nd, 3rd, 4th, and 5th toes, 1st phalanges, base: Lumbricals (from flexor longus digitorum)

Big toe, terminal phalanx: Extensor longus hallucis (from fibula)
2nd, 3rd, and 4th toes, all phalanges: Extensor brevis digitorum (from os calcis dorsal surface)
2nd to 5th toes, all phalanges: Extensor longus digitorum (from tibia and fibula)

Muscles inserted into the foot, plantar aspect.

Tarsus:

Tarsus all bones (except astragulus): Tibialis posterior (from tibia and fibula)
1st cuneiform: Tibialis anterior (from tibia)
1st cuneiform: Peroneus longus (from fibula)

Metatarsals:

2nd to 5th metatarsals, base: Tibialis posterior (from tibia)
1st metatarsal, base: Tibialis anterior (from tibia)
1st metatarsal, base: Peroneus longus (from fibula)

Phalanges:

Big toe, 1st phalanx, base: Abductor hallucis (from os calcis, plantar tubercle)
Big toe, 1st phalanx, base: Flexor brevis hallucis (from cuboid and 3rd cuneiform)
Big toe, 1st phalanx, base: Adductor hallucis (from 2nd, 3rd, 4th metatarsals, bases, and distal ends)
3rd, 4th, and 5th toes, 1st phalanx, base: Plantar interossei (from 3rd, 4th, and 5th metatarsals)
5th toe, 1st phalanx, base: Abductor digiti quinti (from os calcis, plantar tubercles)
5th toe, 1st phalanx, base: Flexor brevis digiti quinti (from 5th metatarsals)
Big toe, terminal phalanx: Flexor longus hallucis (from fibula)
2nd to 5th toes, middle phalanges: Flexor brevis digitorum (from os calcis, plantar tubercles)
2nd to 5th toes, terminal phalanges: Flexor longus digitorum (from tibia)

Muscles arising from the foot, dorsal aspect.

Tarsus:

Os calcis, dorsal surface: Extensor brevis digitorum (to big toe, 1st phalanx, base)
(to 2nd, 3rd, and 4th toes, (all phalanges)

Metatarsus:

1st to 5th metatarsals, shafts: Dorsal interossei (to 2nd, 3rd, and 4th toes, proximal phalanges, base.)

Muscles arising from the foot, plantar aspect.

Tarsus:

Os calcis plantar tubercles and plantar surface: Abductor hallucis (to big toe, 1st phalanx, base)

(Flexor brevis digitorum (to 2nd to 5th toes, middle phalanges)
Os calcis plantar (Abductor digiti quinti (to 5th toe, 1st phalanx, base)
tubercles and plantar surface (Quadratus plantae (to tendon flexor longus digitorum)

Cuboid, 3rd cuneiform: Flexor brevis hallucis (to big toe, 1st phalanx, base).

Metatarsus:

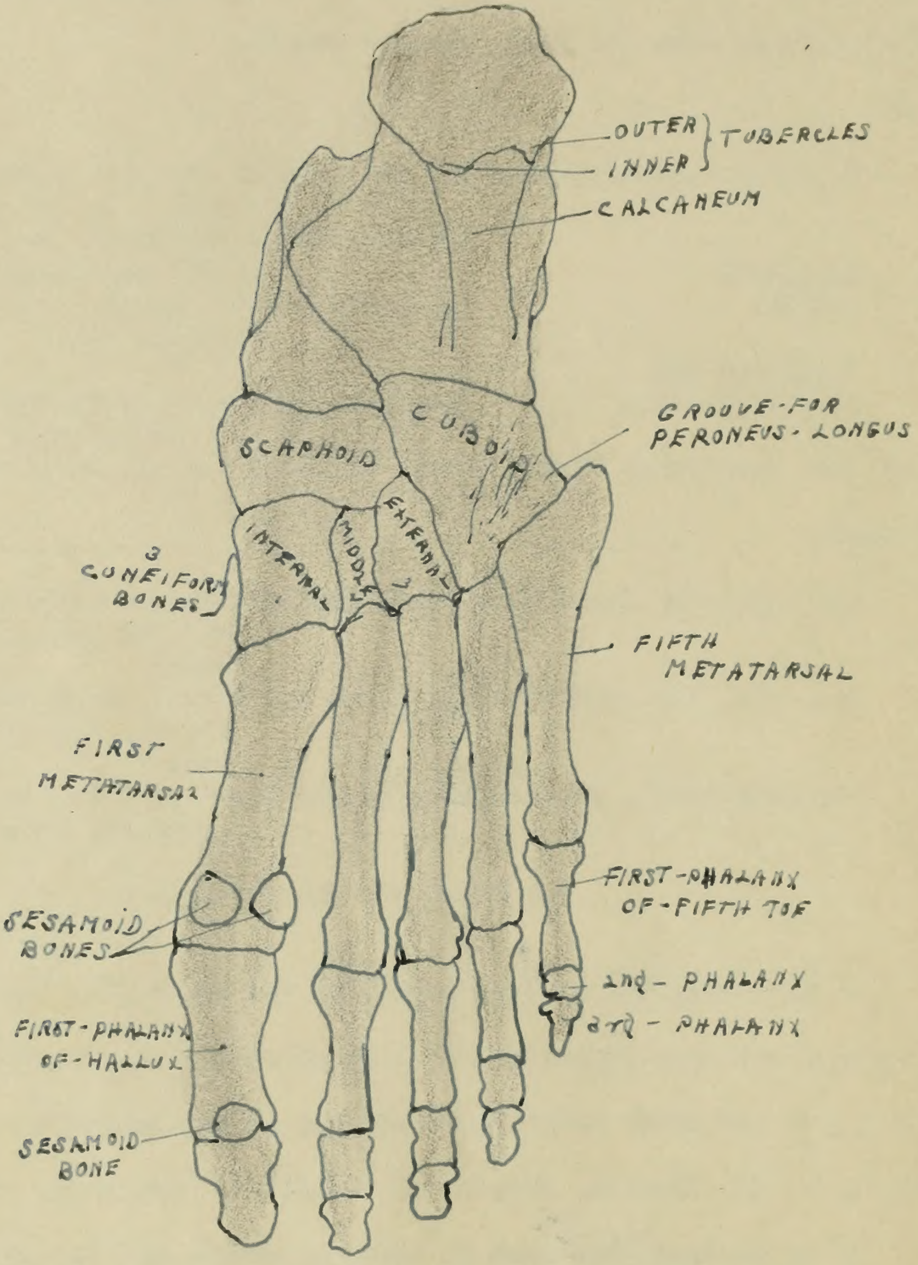
3rd, 4th, and 5th metatarsals, shafts: Plantar interossei (to 3rd, 4th, and 5th toes, 1st phalanges, base)
2nd, 3rd, 4th, metatarsals, bases and distal ends: Adductor hallucis (to big toe, proximal phalanx, base)
5th metatarsal, base: Flexor brevis digiti quinti (to 5th toe, 1st phalanx, base)

See Pages 65, 66, 67, and 68.

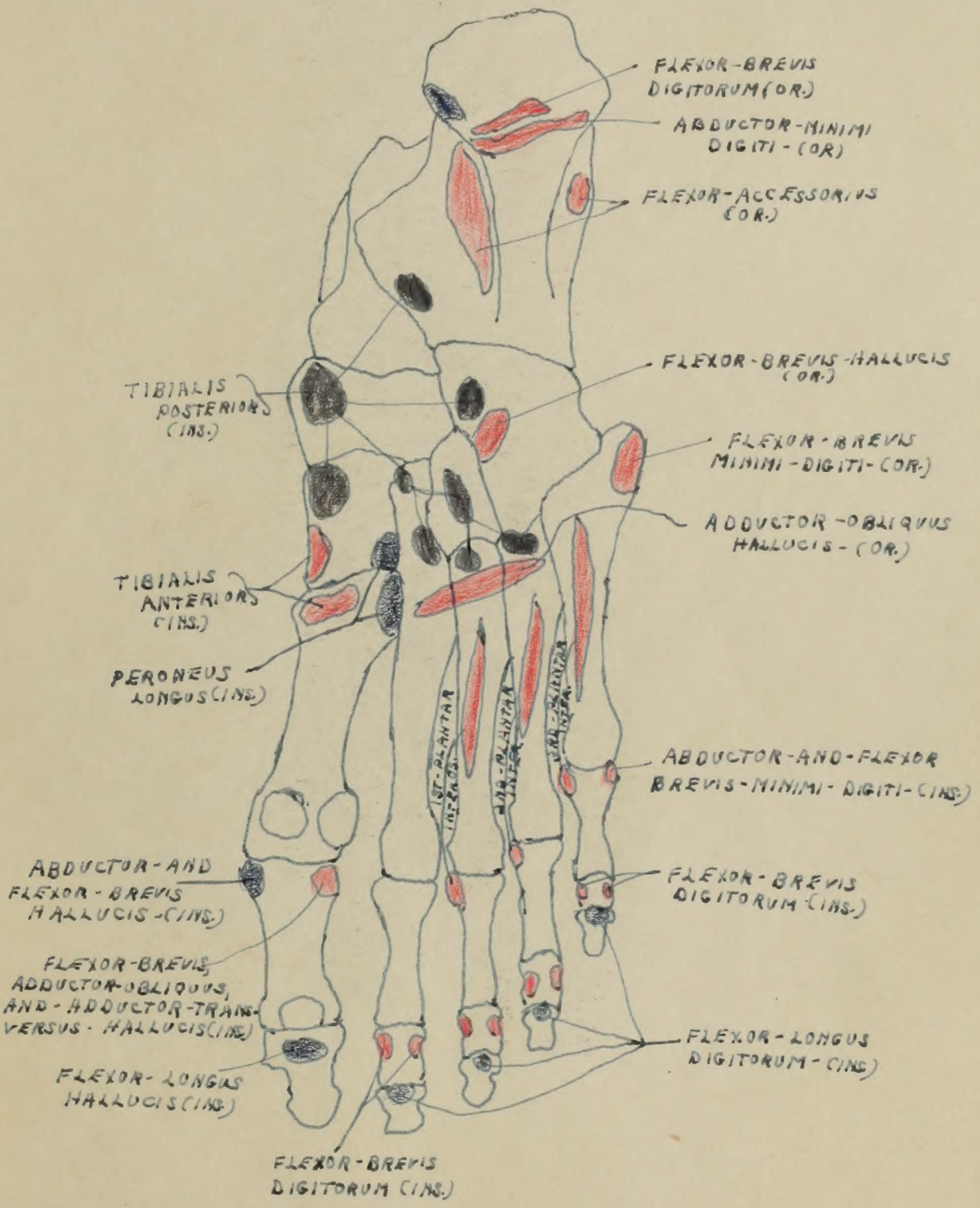
I have completed my description of the bones with their muscular attachments and as a summarization I am going to list the muscular actions of the upper and lower extremity according to recognized Physical Education movement, i. e., Flexion, extension, abduction, adduction, etc.

As an insight into some of these movements and for showing the location of these muscles I have included in the summarization several illustrations which show the position of the shoulder, arm, and forearm, and the muscular location. The same is true for the lower extremity showing the thigh and leg muscular location. By such a visualization, the student will get a better idea of the Osseous and Muscular systems of the Human Body.

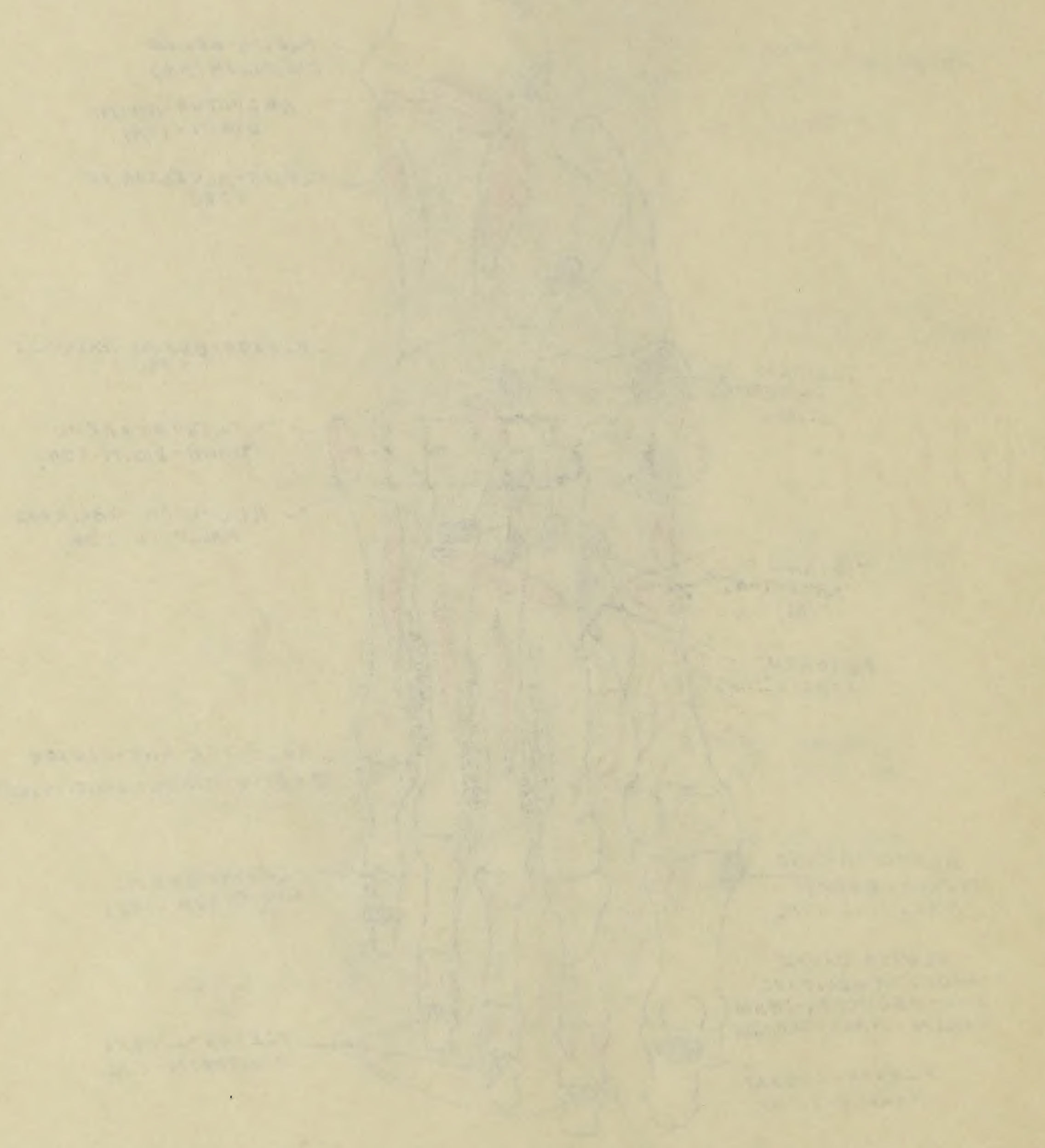
The bones of the right foot, viewed from below. (Spalteholz.)



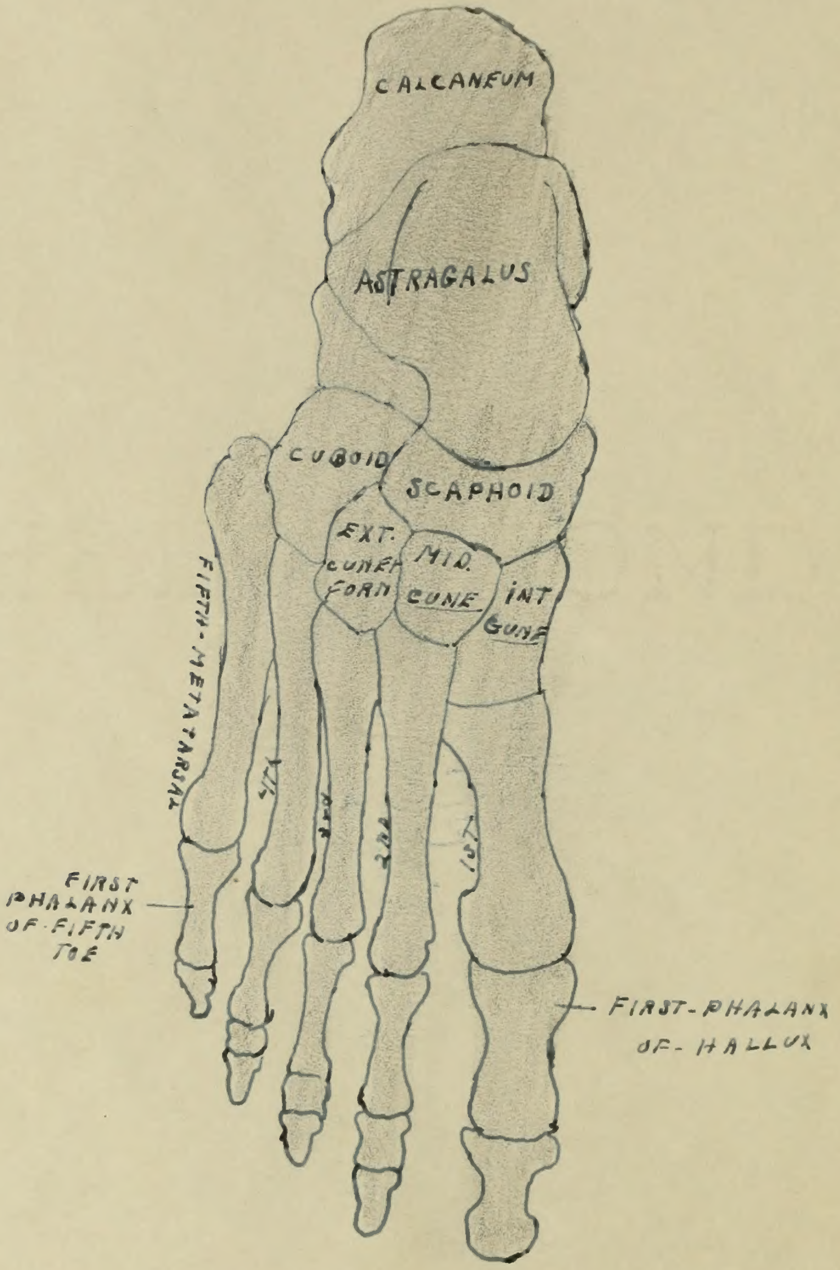
Areas of muscular attachment on the plantar surface of the bones of the foot. Where the areas of origin and insertion are both presented they are in the same color. OR., origin; INS., insertion. The insertion of the second and third tendons of the flexor brevis digitorum are not labeled. (Gerrish.)


FLEXOR-BREVIS DIGITORUM (OR.)
ABDUCTOR-MINIMI DIGITI-(OR)
FLEXOR-ACCESSORIUS (OR.)
TIBIALIS POSTERIOR (INS.)
FLEXOR-BREVIS-HALLUCIS (OR.)
FLEXOR-BREVIS MINIMI-DIGITI-(OR.)
ADDUCTOR-OBLIQUUS HALLUCIS-(OR.)
TIBIALIS ANTERIOR (INS.)
PERONEUS LONGUS (INS.)
1ST-PLANTAR INTER.
2ND-PLANTAR INTER.
3RD-PLANTAR INTER.
ABDUCTOR-AND-FLEXOR BREVIS-MINIMI-DIGITI-(INS.)
ABDUCTOR-AND FLEXOR-BREVIS HALLUCIS-(INS.)
FLEXOR-BREVIS DIGITORUM (INS.)
FLEXOR-BREVIS, ADDUCTOR-OBLIQUUS, AND-ADDUCTOR-TRANSVERSUS-HALLUCIS(INS.)
FLEXOR-LONGUS DIGITORUM-(INS.)
FLEXOR-LONGUS HALLUCIS(INS.)
FLEXOR-BREVIS DIGITORUM (INS.)

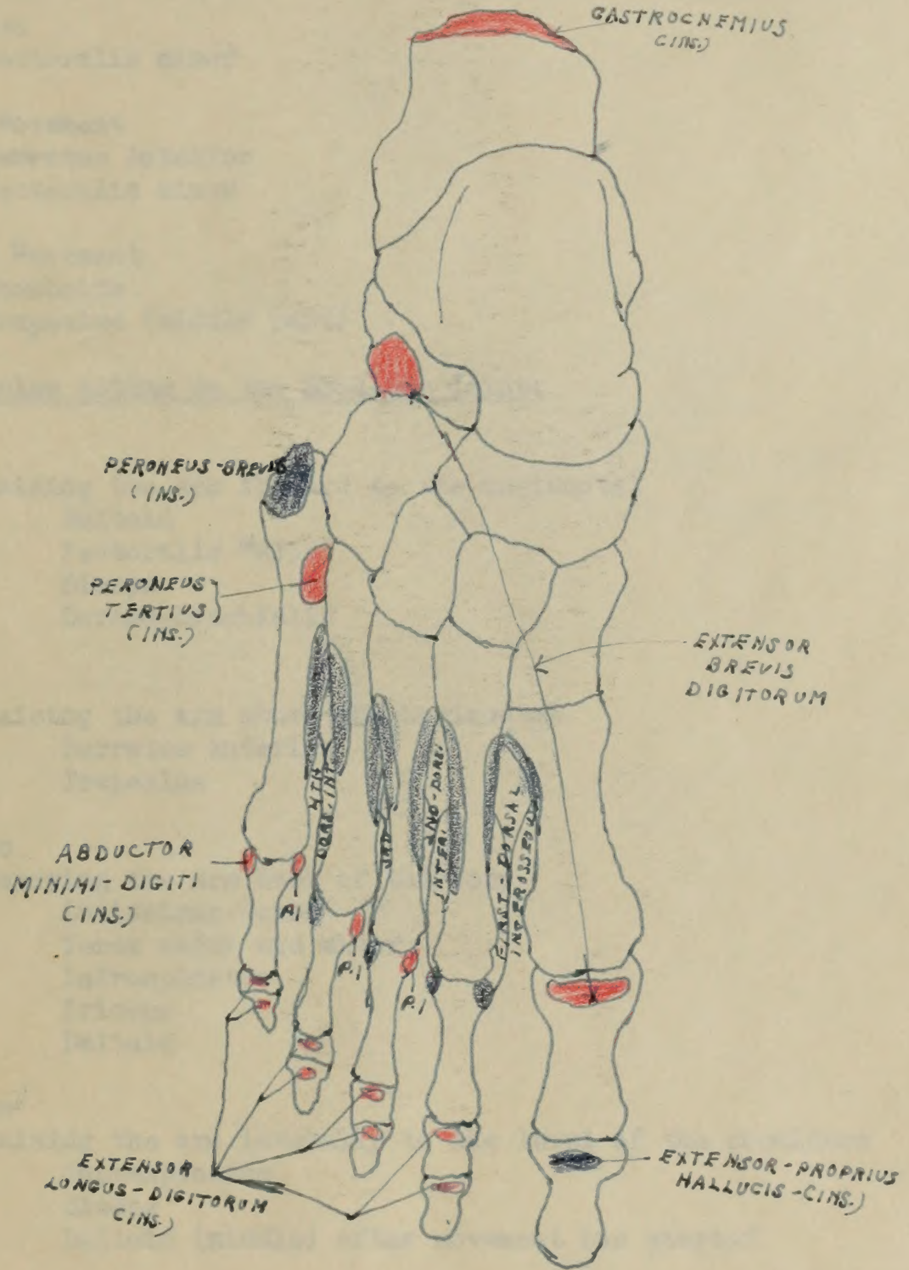
[illegible]



The bones of the right foot, viewed from above. (Albinus.)



Areas of muscular attachment on the dorsal surface of the bones of the foot. Where the areas of origin and insertion are both presented they are in the same color. P.I., plantar interosseous insertion; INS., insertion. (Gerrish.)


GASTROCNEMIUS (INS.)
PERONEUS-BREVIS (INS.)
PERONEUS-TERTIUS (INS.)
EXTENSOR BREVIS DIGITORUM
4TH DORS. INT.
3RD
2ND-DORS. INTER.
FIRST-DORSAL INTEROSSEOUS
ABDUCTOR MINIMI-DIGITI (INS.)
P.I
P.I
P.I
EXTENSOR LONGUS-DIGITORUM (INS.)
EXTENSOR-PROPRIUS HALLUCIS-(INS.)

Muscular Action of the Upper Extremity

Muscles acting directly on the shoulder girdle:

Elevation of the Shoulder girdle
- Trapezius (upper part)
- Levator scapulae
- Romboids (upper fibers)

Depression
- Pectoralis minor

Forward Movement
- Serratus Anterior
- Pectoralis minor

Backward Movement
- Rhomboids
- Trapezius (middle part)

Muscles acting on the Shoulder Joint:

Flexion
- Raising the arm forward to the horizontal
  - Deltoid
  - Pectoralis Major
  - Biceps
  - Coraco-brachialis

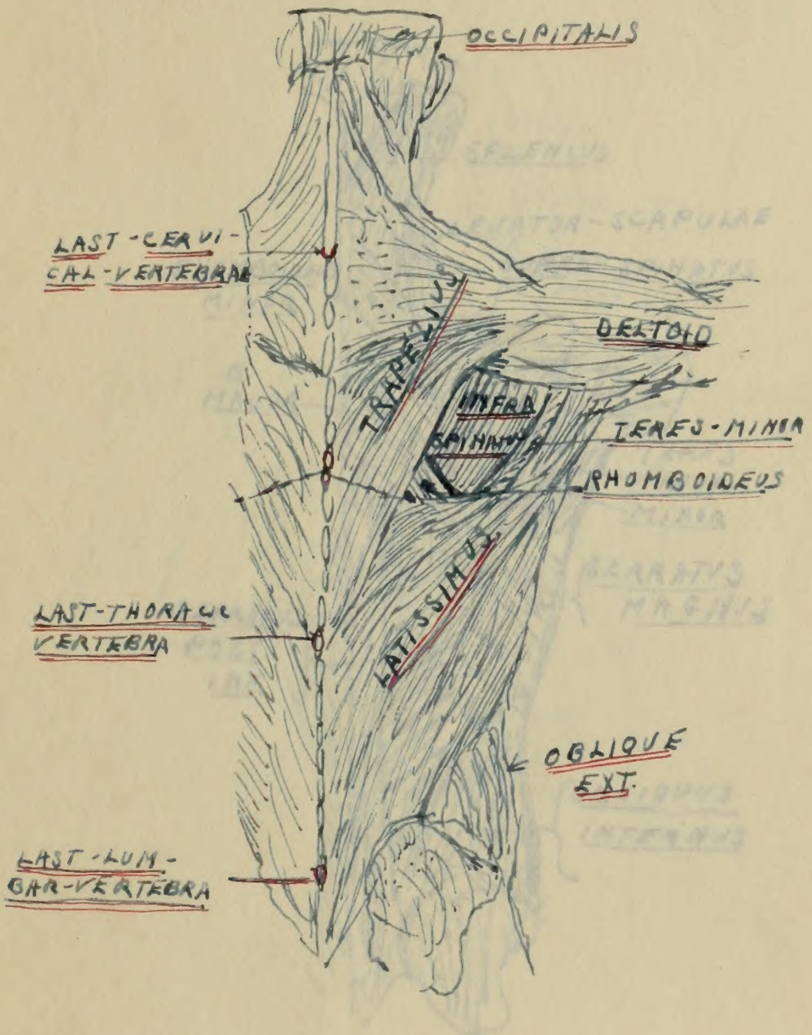
Flexion
- Raising the arm above the horizontal
  - Serratus anterior
  - Trapezius

Extension
- Carrying the arm back of the body
  - Latissimus dorsi
  - Teres major and minor
  - Infraspinatus
  - Triceps
  - Deltoid

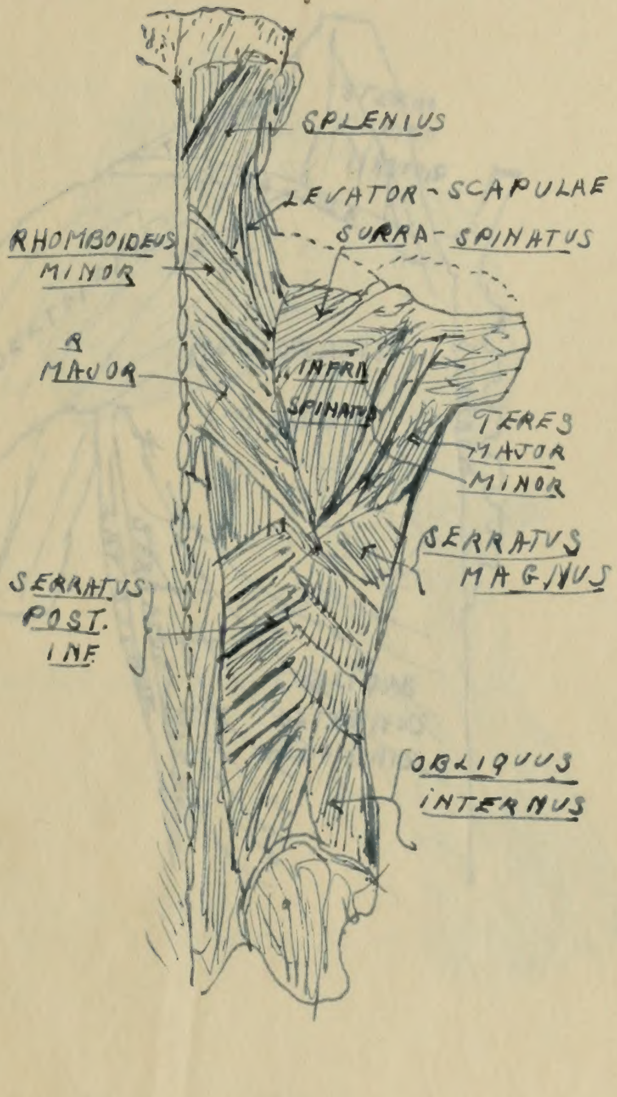
Abduction
- Raising the arm laterally to the level of the shoulders
  - Supraspinatus
  - Biceps
  - Deltoid (middle) after movement has started

Abduction
- Raising the arm above the level of the shoulder
  - Trapezius
  - Serratus anterior

MUSCLES IN THE SUPERFICIAL LAYER OF THE BACK.

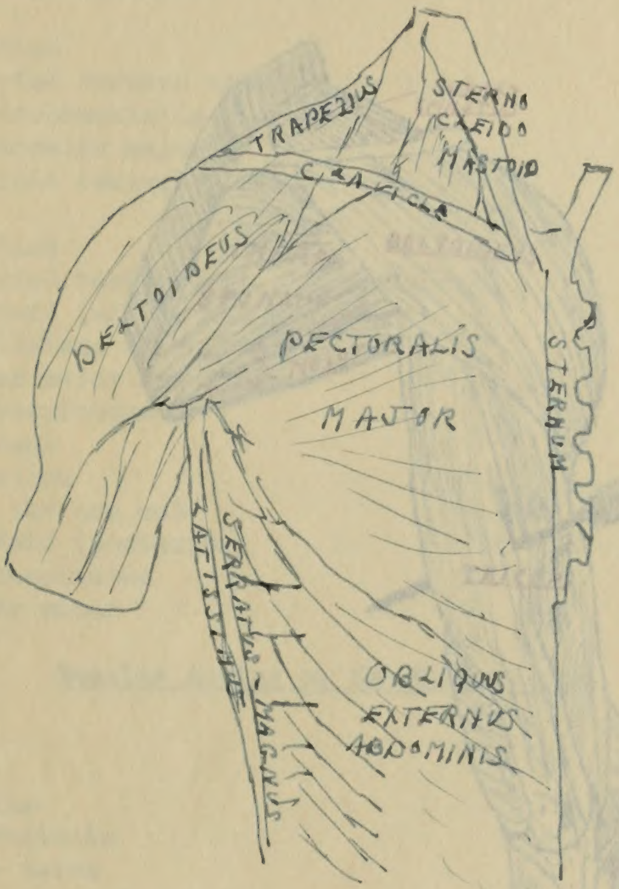


MUSCLES IN THE SECOND LAYER OF THE BACK AND ON THE DORSUM OF THE SHOULDER.

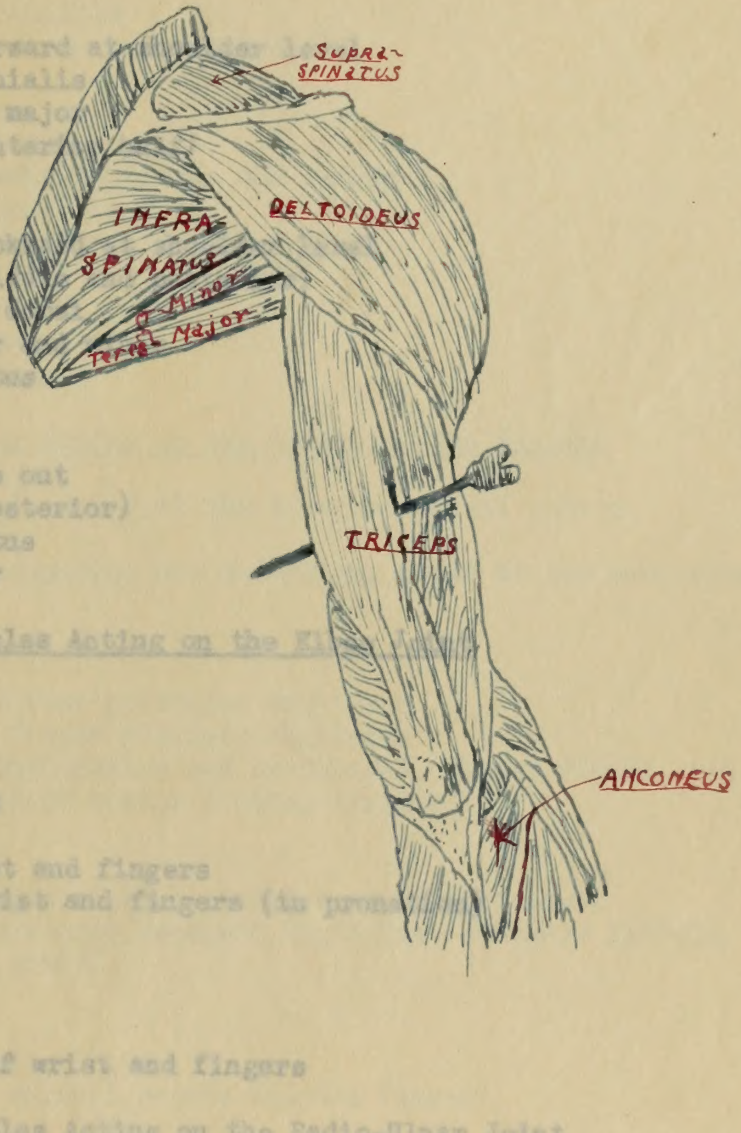


SUPERFICIAL MUSCLES,

FRONT OF CHEST AND SHOULDER OF RIGHT SIDE.



MUSCLES ON THE DORSUM
OF THE RIGHT SHOULDER AND THE ARM. (Testut)



Adduction
- Bring the arm to the side
  - Latissimus dorsi
  - Triceps
  - Infraspinatus
  - Teres major and minor
  - Pectoralis major
  - Deltoid
  - Coracobrachialis

Horizontal adduction
- Arm carried forward at shoulder level
  - Coracobrachialis
  - Pectoralis major
  - Deltoid (anterior half)

Horizontal abduction
- Arm carried backward at shoulder level
  - Deltoid (middle and posterior)
  - Latissimus dorsi
  - Teres major and minor
  - Infraspinatus
  - Triceps

Medial rotation
- Turning the arm out
  - Deltoid (posterior)
  - Infraspinatus
  - Teres minor

Muscles Acting on the Elbow Joint

Flexion
- Biceps
- Brachialis
- Brachioradialis
- Pronator teres
- Flexors of wrist and fingers
- Extensors of wrist and fingers (in pronation)

Extension
- Triceps
- Anconeus
- Extensors of wrist and fingers

Muscles Acting on the Radio-Ulnar Joint

Pronation
- Pronator radii teres
- Pronator quadratus
- Flexor carpi radialis

Supination
- Biceps
- Supinator (brevis)
- Extensors of wrist and thumb

Muscles Acting on the Wrist Joint

Flexion
Flexor carpi radialis
Flexor carpi ulnaris
Palmaris Longus
Long flexors of thumb and fingers

Extension
Extensor carpi radialis longus and brevis
Extensor carpi ulnaris
Abductor longus pollicis
Extensors of the thumb and fingers

Abduction (Radial flexion)
Flexor carpi radialis
Extensor carpi radialis longus and brevis
Abductor longus pollicis
Extensor longus pollicis

Adduction (Ulnar flexion)
Flexor carpi ulnaris
Extensor carpi ulnaris

Muscles Acting on the Joints of the Fingers

Flexion and extension only occur at the interphalangeal joints.

Flexion and extension, adduction and abduction, occur at the metacarpophalangeal joints.

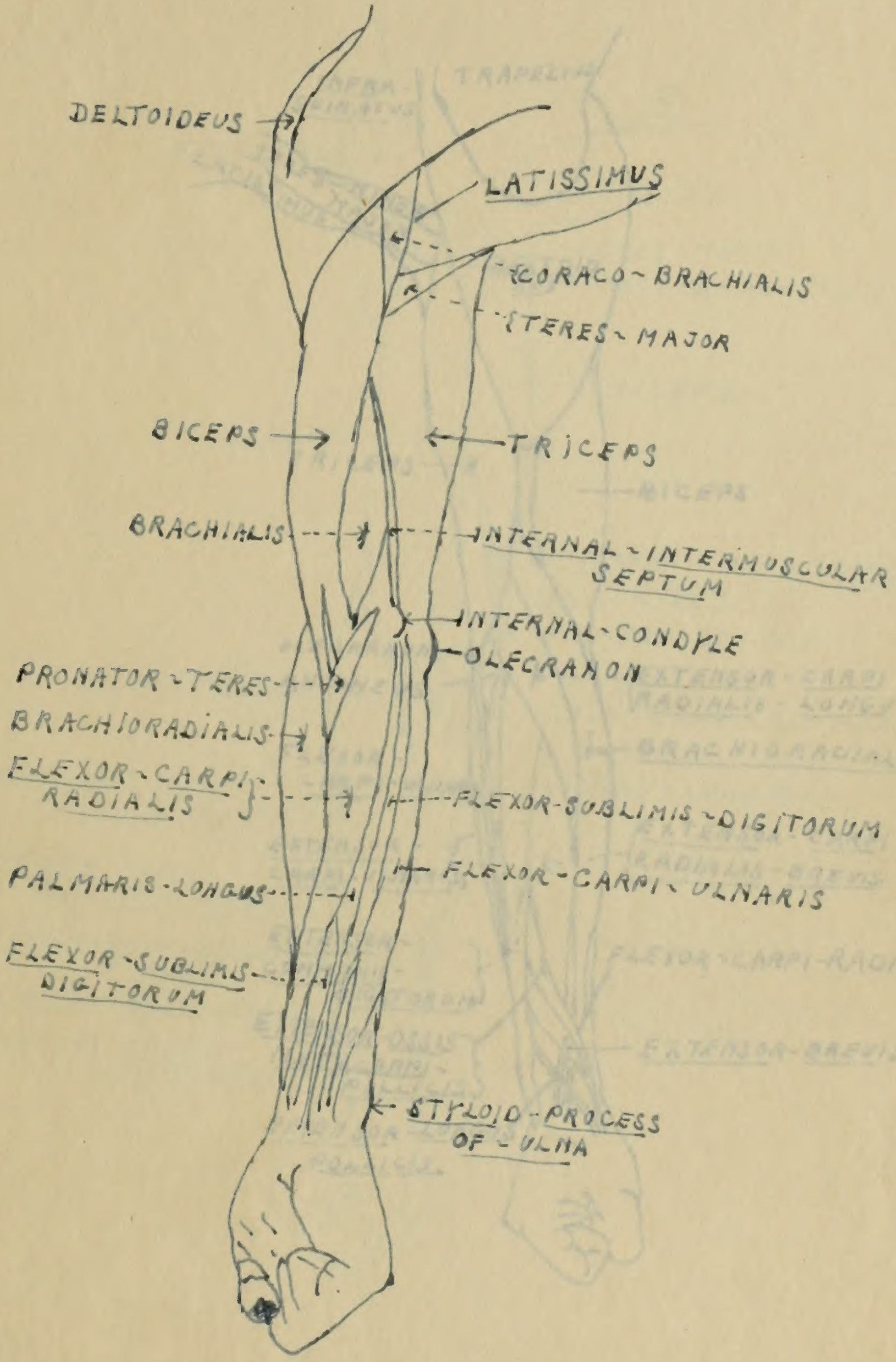
Flextion
Third phalanx, flexor profundus digitorum
Second phalanx, flexor sublimis digitorum
First phalanx, lumbricales and interossei, flexor digiti, and abductor digiti quinti brevis (little finger)

Extension
Third and second phalanges, interossei, lumbricales.
All phalanges, extensor communis digitorum, extensor indicis, extensor digiti quinti

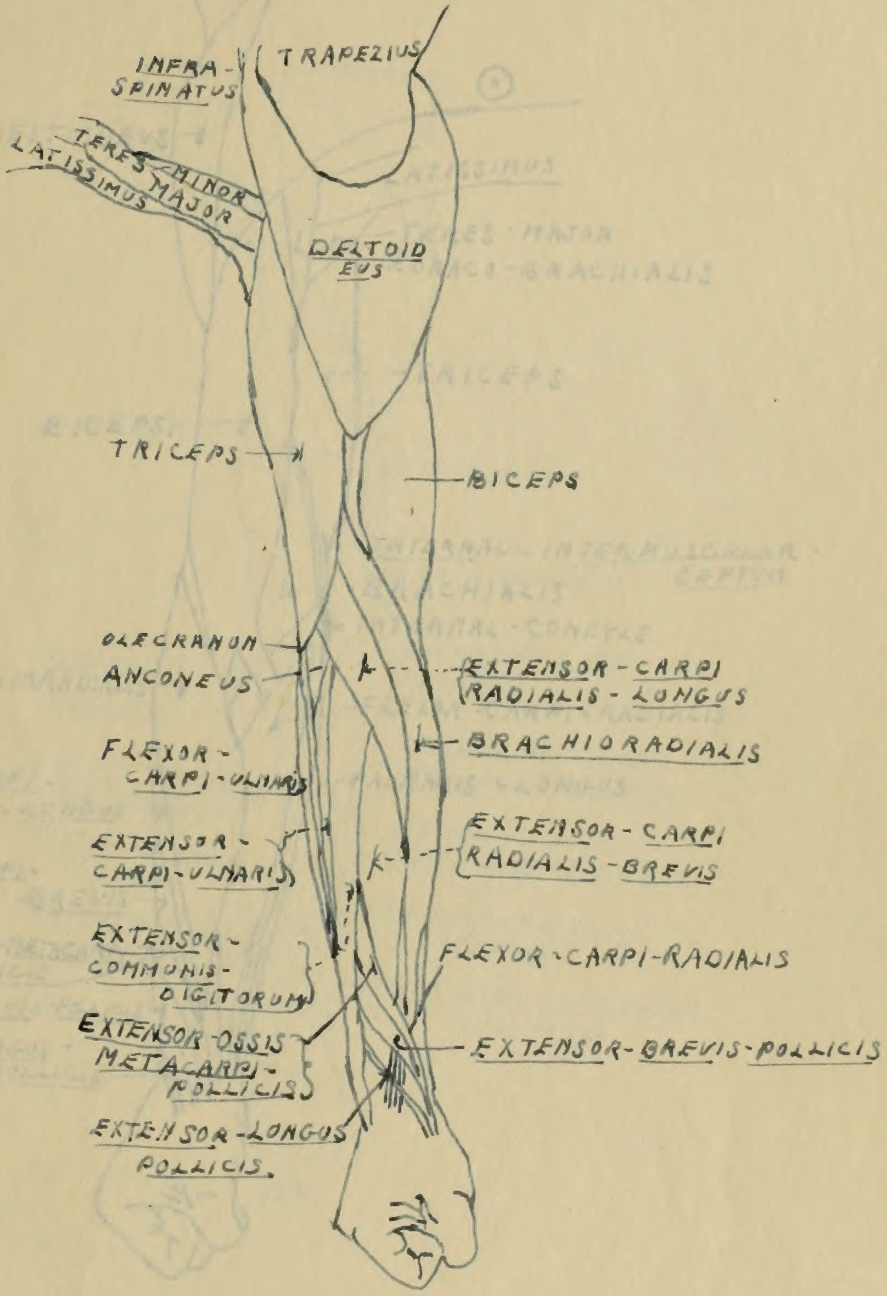
Abduction
Dorsal interossei
Abductor digiti quiniti brevis (little finger)

Adduction
Palmar interossei.

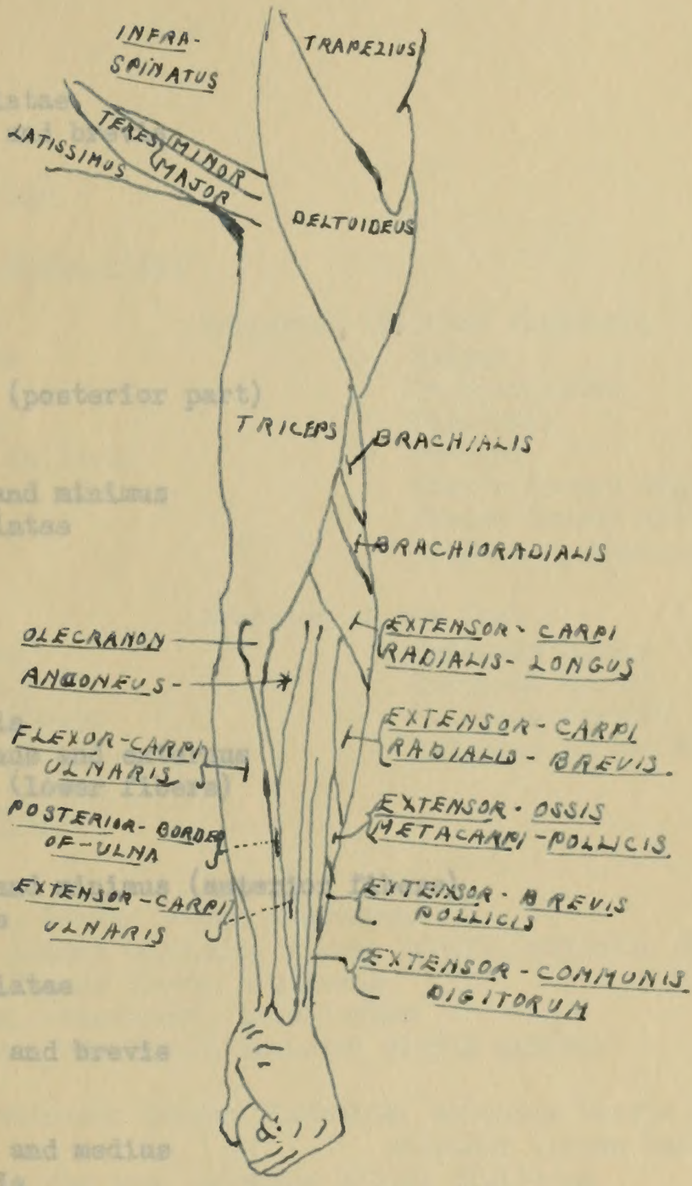
THE RIGHT UPPER LIMB ABDUCTED AND SUPINATED VIEWED FROM IN FRONT.



THE RIGHT UPPER LIMB, ABDUCTED AND SUPINATED VIEWED FROM BEHIND.



THE RIGHT UPPER LIMB, ABDUCTED AND PRONATED VIEWED FROM BEHIND.


INFRA-SPINATUS
TRAPEZIUS
TERES MINOR
LATISSIMUS
MAJOR
DELTOIDEUS
TRICEPS
BRACHIALIS
BRACHIORADIALIS
OLECRANON
ANCONEUS
EXTENSOR - CARPI RADIALIS - LONGUS
FLEXOR - CARPI ULNARIS
EXTENSOR - CARPI RADIALIS - BREVIS
POSTERIOR - BORDER OF - ULNA
EXTENSOR - OSSIS METACARPI - POLLICIS
EXTENSOR - CARPI ULNARIS
EXTENSOR - BREVIS POLLICIS
EXTENSOR - COMMUNIS DIGITORUM

Muscular Action of the Lower Extremity

Muscles acting on the hip joint:

Flexion:
- Iliopsoas
- Sartorius
- Pectineus
- Rectus
- Tensor fasciae latae
- Adductor longus and brevis
- Gracilis
- Gluteus minimus

Extension
- Gluteus minimus
- Gluteus medius
- Hamstrings
- Adductor magnus (posterior part)

Abduction
- Gluteus medius and minimus
- Tensor fasciae latae

Adduction
- Adductors
- Gracilis
- Pectineus
- Quadratus femoris
- Obturator internus and externus
- Gluteus maximus (lower fibers)

Rotation Inward
- Gluteus medius and minimus (anterior fibers)
- Semi-membranosus
- Semitendinosus
- Tensor fasciae latae
- Iliopsoas
- Adductor longus and brevis

Rotation Outward
- Gluteus maximus and medius
- Quadratus femoris
- Obturators and gemelli
- Pyriformis
- Adductor magnus (lower part)
- Biceps
- Sartorius
- Gracilis

Muscles Acting on the Knee Joint:

Flexion:

- Biceps
- Semitendinosus
- Semimembranosus
- Gastrocnemius
- Popliteus
- Sartorius
- Gracilis

Extension

- Quadriceps extensor

Muscles Acting on the Ankle Joint:

Flexion (dorsi flexion):

- Tibialis anterior
- Extensor longus digitorum
- Peroneus tertius
- Extensor longus hallucis

Extension (plantar flexion):

- Soleus
- Gastrocnemius
- Plantaris
- Peronei
- Flexor longus digitorum
- Flexor longus hallucis
- Tibialis posterior

Inversion of the foot

- Tibialis anterior
- Tibialis posterior
- Flexor longus hallucis

Eversion of the foot

- Peroneus longus
- Peroneus brevis
- Peroneus tertius
- Extensor longus digitorum

Muscles Acting on the Toes:

Flexion:

- Terminal phalanx, Flexor longus digitorum
- Big toe, Flexor longus hallucis, flexor brevis, hallucis abductor
- Middle phalanx, Flexor brevis digitorum
- Proximal phalanx, Interossei, lumbricales
- Little toe, Flexor brevis and abductor digiti quinti.

Extension

- All phalanges, Extensor longus digitorum, extensor brevis digitorum, extensor longus hallucis
- Proximal phalanx, big toe, Extensor brevis digitorum
- Middle and Terminal phalanges, Interossei and Lumbricales

Abduction

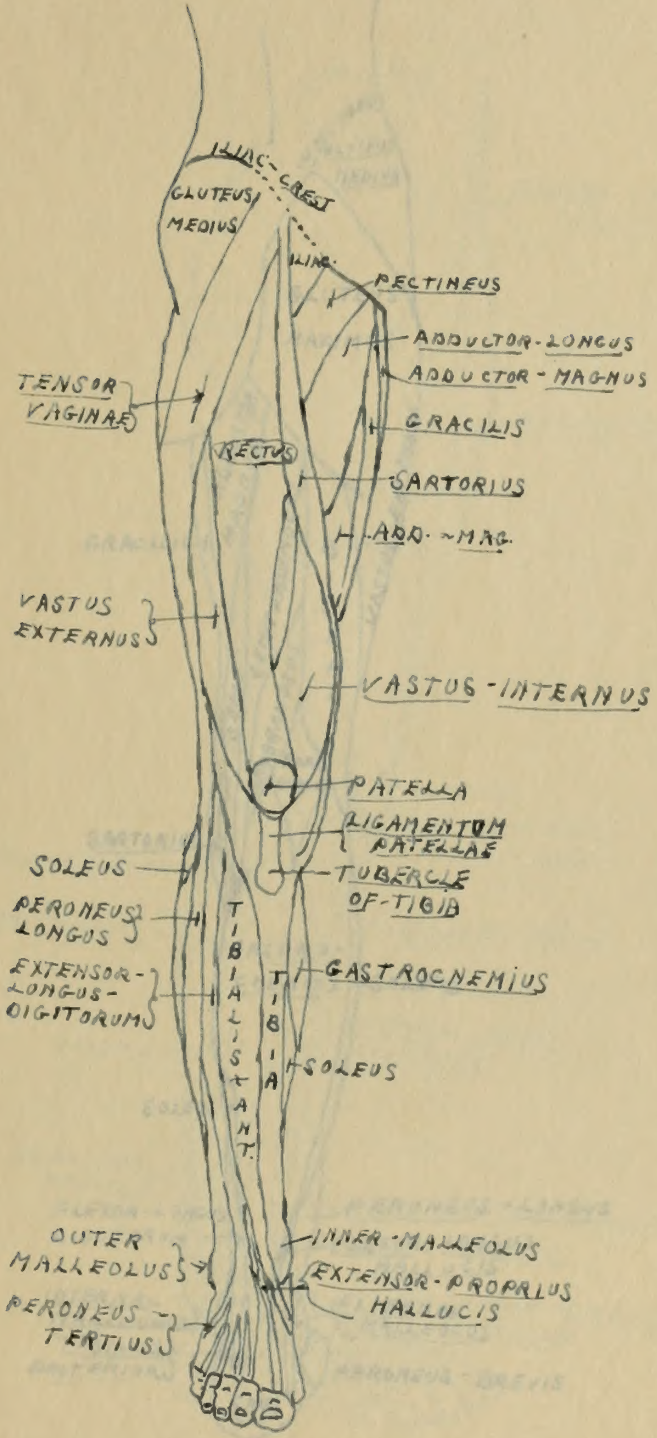
- Dorsal interossei, 2nd, 3rd, 4th toes; Abductors of 1st and 5th toes.

Adduction

- Plantar interossei, 3rd, 4th, 5th toes; Adductor of big toe.

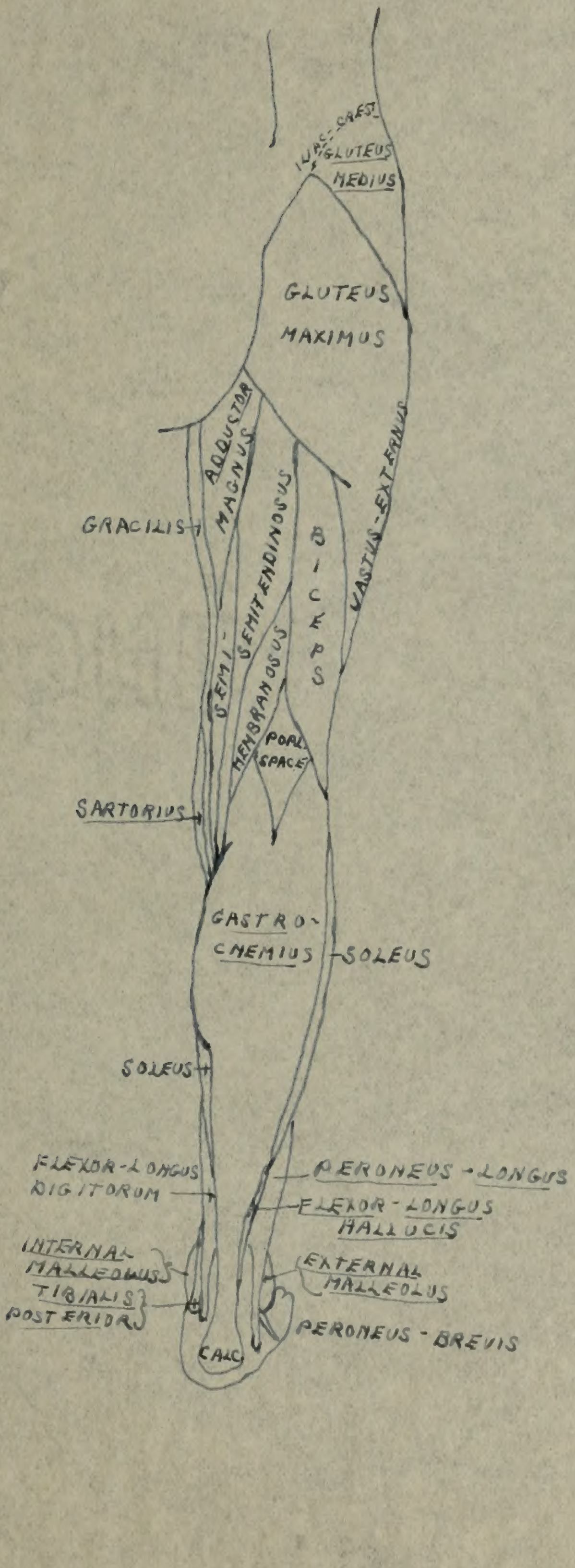
THE RIGHT LOWER LIMB,

FRONT VIEW.



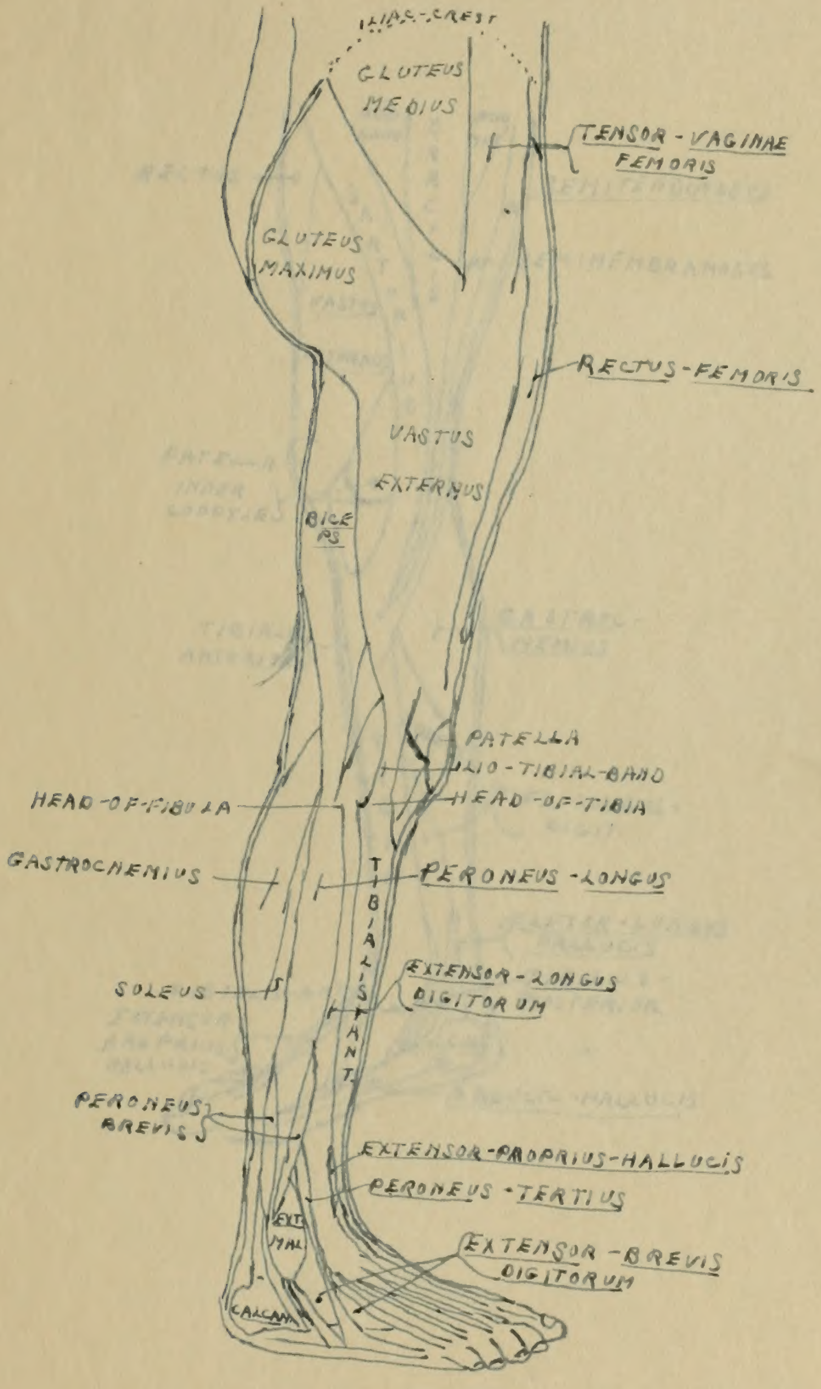
THE RIGHT LOWER BIMB,

REAR VIEW.



THE RIGHT LOWER LIMB,

EXTERNAL LATERAL VIEW.



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